1996 Southern Paiute Consortium *Colorado River Corridor* Monitoring and Education Program Summary Report

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University of Arizona
Tucson, Arizona

September 1996

Report of work carried out under Southern Paiute Consortium Cooperative Agreement with the Bureau of Reclamation, #4-FC-40-15620

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Introduction

This report summarizes the results of the 1996 Southern Paiute Consortium (SPC) Colorado River Corridor Monitoring and Environmental Education program. The basis for the program and the results of its initial development and implementation are discussed fully in the report, *Itus, Auv, Te'ek (Past, Present, Future): Managing Southern Paiute Resources in the Colorado River Corridor* (Stoffle, Austin, Fulfrost, Phillips, and Drye 1995).

The 1996 program had three major goals: (1) modification and implementation of the Southern Paiute Consortium's monitoring program; (2) education and training of Southern Paiute monitors and teenage youth; and (3) initial development of an archival program and multimedia database. All of these goals were accomplished during 1996. Regular monitoring activities were conducted during a two day trip between Glen Canyon Dam and Lees Ferry and a twelve day trip between Lees Ferry and Diamond Creek. The SPC participated in two additional trips, a one day trip between Glen Canyon Dam and Lees Ferry and a fourteen day trip between Lees Ferry and Diamond Creek, to examine the impacts of the March-April controlled flood release from Glen Canyon Dam. The results of the SPC controlled flood research are reported in Austin and Osife (1996). Additional monitoring information obtained during the controlled flood research trips is provided in this report.

This report is organized in four chapters. Chapter One summarizes the results of monitoring at each of the SPC monitoring sites visited during 1996. The chapter also provides recommendations for future monitoring and identifies tasks for 1997. Chapter Two summarizes the results of the education and training component of the 1996 program and provides recommendations for the future. Chapter Three summarizes the SPC archival program, with particular emphasis on the development of a multimedia database. The chapter also outlines priority tasks for 1997. The final chapter provides a brief summary and discussion of the 1996 program.

CHAPTER ONE

CULTURAL RESOURCES MONITORING

The 1996 Southern Paiute Consortium (SPC) Colorado River Corridor cultural resources monitoring program operated between May and September. The program included one river trip between Glen Canyon Dam and Lees Ferry, two river trips between Lees Ferry and Diamond Creek, data entry and analysis, and report preparation. The purpose of program was to conduct transitional monitoring as recommended by the Glen Canyon Dam Environmental Impact Statement. The monitoring program included training and was conducted at the same time as the environmental education program (see Chapter Two). This chapter summarizes the activities of the river trips and provides recommendations for the 1997 cultural resources monitoring program.

The SPC monitoring program was developed to evaluate the effects of the Glen Canyon Dam on cultural resources that have been identified by Southern Paiute consultants within the Colorado River Corridor. Southern Paiutes have been involved in the Glen Canyon Environmental Studies (GCES) of the Bureau of Reclamation (BOR) program to investigate cultural resource issues since 1992. In 1995, the SPC, on behalf of the Kaibab Paiute Tribe and the Paiute Indian Tribe of Utah, began the development and testing of a cultural resource monitoring program. The SPC designed the 1996 monitoring research study to complement the existing program.

Methodology

As recommended in 1995, the 1996 monitoring program was modified in several ways. First, the SPC cultural resource monitoring forms were consolidated into a single form. Therefore, at each site, one cultural resource monitoring form was completed, and only the sections pertinent to the site were filled out. Second, site-specific monitoring checklists were developed for each site prior to the river trips. These checklists indicated both priority tasks to be accomplished during the monitoring trip and additional tasks to complete if time allowed. Third, the method of installing and reading transects was standardized so all transects begin away from the river and run toward the water. Fourth, a Southern Paiute Consortium Tribal Monitors Training Program was developed. The program includes nine activities designed to develop skills in (1) creating site maps, (2) establishing and using photo points, (3) installing and reading transects, and (4) conducting spiritual monitoring (see Appendix A for program outline). Fifth, a Southern Paiute plant reference guide was created for use by monitors in the field. That reference guide was also incorporated into the SPC multimedia database and archival program (see Chapter Three). Finally, a monitoring program managers' guidebook was developed. The guidebook outlines the tasks to be completed each year before and after the monitoring trip and discusses the format of the annual report.

The 1996 monitoring program included three river trips. An additional trip between Glen Canyon Dam and Lees Ferry occurred in February as a precursor to the 1996 Glen Canyon Dam Beach/Habitat Building Test Flow (hereafter referred to as "Test Flow"). Prior to each trip, the SPC monitoring team worked together to coordinate efforts necessary for completing the monitoring program. The first downriver trip of 1996 was the Southern Paiute post-flood monitoring research trip that began May 8 at Lees Ferry and ended May 22 at Diamond Creek. The purpose of the trip was to evaluate the effects of the Test Flow on cultural resources within the region potentially impacted by water flowing at 45,000 cfs (see Austin and Osife 1996; Appendix B). The SPC Test Flow downriver research was conducted by (1) the Coordinator of the SPC, (2) a researcher from the Bureau of Applied Research in Anthropology at the University of Arizona (UofA), and (3) a consulting botanist. Most of the annual botanical monitoring was completed during that trip, and the findings that are not included in the Test Flow report are included in this chapter.

An SPC upriver trip occurred May 30 and 31 between Glen Canyon Dam and Lees Ferry. The monitoring was carried out by (1) one Southern Paiute monitor, (2) five student researchers, and (3) two researchers from the UofA. The researchers conducted Test Flow research and completed the regular monitoring while at the sites.

The second downriver trip of 1996 was the Southern Paiute monitoring and education trip that began June 12 at Lees Ferry and ended June 23 at Diamond Creek. The monitoring was carried out by (1) the Coordinator of the SPC, (2) two Southern Paiute elders, (3) seven Southern Paiute student researchers, (4) two researchers from the UofA, and (5) two Southern Paiute monitors.

Twenty-two (22) SPC monitoring sites were monitored as shown in Table 1.1. At certain sites the two elders conducted Paiute cultural activities. Special attention was paid to the time required to complete work at each site and the frequency with which the site should be monitored in the future to ensure that the impacts of the Glen Canyon Dam are fully understood. This information is shown in Table 1.1.

Table 1.1 Monitoring/Educational Research Study Sites

Date	Site	Activities Completed	Time (min.)	Next Monitoring
Feb. 8, May 31	SPC #1 Glen Canyon Petroglyph	Installed belt and line intercept transects* Established photo points Completed rock art monitoring	180	5/97
May 30	SPC #2 Mixed Petroglyph	Established photo points Completed rock art monitoring	NR^	5/97
Feb. 8, May 30	SPC #3 Ferry Swale	Installed segmented belt transect* Established photo points	NR	5/97
May 8, June 13	SPC #4 Jackass Cyn.	Reinstalled segmented belt transect* Completed photo documentation of site	140 153	6/97
May 9, June 13	SPC #5 South Canyon	Established photo points for Locus 2 Completed archaeological monitoring of Locus 2b Not monitored in June due to ceremonial and spiritual reasons.	160	6/97
May 10-11, June 14	SPC #6 Nankoweap	Surveyors located plot boundaries* Relocated and measured plants in plots Reinstalled segmented belt transect* Completed photo documentation of site Reviewed documentation of previously unmonitored archaeology site	570 128	6/97
May 11	SPC #7 Lava Chuar	Photographed eroding edge of archaeological site	30	6/99
May 12, June 16	SPC #8 Tanner	Established photo points to monitor trail erosion Photographed the six rock art boulders Re-shot overview photographs Re-shot and established photo points Fixed site map (of July 95)	60 57	6/97
May 15	SPC #9 Bedrock Canyon	Established photo points for remote monitoring Relocated and measured plants in plots*	150	6/99
May 15, June 17	SPC #10 Deer Creek	Completed photo documentation of beach Relocated and measured plants in plots Established photo points to monitor trail erosion Photographed panel (A to N)-overviews and close-ups Reconstructed site map Completed pilot visitor monitoring forms	125 210	6/97
May 16, June 17	SPC #11 Kanab Creek	Reinstalled segmented belt transect - extended to incorporate archaeology Did not monitor in June due to not finding camp site above Kanab Creek.	1800	6/97
June 18	Ledges Springs	Established photo points of roasting pit and spring Photographed overviews of roasting pit and spring	65	6/97

June 19	Cove Canyon	Photographed site overviews	45	6/98
May 17	SPC #12 Vulcan's Anvil - L#1	Reinstalled line intercept transect* Completed TCP monitoring	150	6/99
June 19	SPC #12 Vulcan's Anvil -L#2&3	Photographed overviews of Loci #2, #3 Re-shot photo documentation on Loci #2, #3. Recorded photo points on site maps	120	6/98
June 20	SPC #12 Vulcan's Anvil -L#4	Completed monitoring; redrew site map Completed photodocumentation	40	6/97
May 18	SPC #12 Vulcan's Anvil -L#5	Completed photo documentation of rock art panel and pond Surveyors located entire exterior of pond	330	6/99
May 18, June 20	SPC #13 Whitmore Wash	Surveyors relocated transect points* Reinstalled line intercept transect* Overview and re-shot photo documentation. Drew a site map. Recorded photo points.	240 160	6/97
May 19	SPC #14 Pre-Parashant	Surveyors relocated transect points* Reinstalled line intercept transect - extended to incorporate rock art panels*	180	6/97
June 21	SPC #15 Ompi Cave	Visited. Did not monitor due to ceremonial and spiritual reasons.	0	6/97
May 19-20 June 21	SPC #16 Spring Canyon	Relocated and measured plants in plots Surveyors relocated transect endpoints* Reinstalled 11 line intercept transects* Re-shot photo documentation Photographed overview and close-ups	420 90	6/97
May 21	SPC #17 Pumpkin Spring	Completed photo documentation and monitoring of TCP*	40	6/97
June 22	SPC #18 Indian Canyon	Established photo points at Locus #1. Re-shot photo documentation at Loci #2, #3. Drew map for all loci.	150	6/98

* Monitoring took place as part of the SPC Test Flow research. For details, see Appendix B.
^ Not recorded.

Site By Site Discussions

In this section, site by site discussions describe findings at each site that was monitored during the 1996 river trips. The summaries of the sites include descriptions of plants, rock art, archaeology and other cultural properties, plus any recommendations for revisions to the monitoring program or for actions to be taken by management agencies regarding the site. For detailed site descriptions, please refer to Stoffle, Austin, Fulfrost, Phillips, and Drye (1995).

GLEN CANYON PETROGLYPH - MONITORING SITE #1

At this site, rock art and plants are included in the SPC monitoring program.

Plants

In February, a 50 m segmented belt transect was installed in the plant community upriver from the rock art panel. The transect was photographed and the general condition of the plants within each segmented was noted. However, there was no botanist present, so the vegetation monitoring data are incomplete. The belt transect was reinstalled in May to evaluate the impacts of the Test Flow. There were no observed impacts to the plants at this site.

Rock Art

This site includes a large rock art panel. The February trip effort focused on establishing photo points to monitor the condition of the panel. Photographs were taken at the established photo points and impacts documented at this site. There were no observed natural impacts to the rock art. Human impacts include dust cover caused by foot traffic and new graffiti. "Joe 95" was lightly scratched into the panel.

All tasks on the monitoring checklist were completed in May. A new line intercept transect was located to incorporate the rock art panel. The photographs were retaken at the established photo points and impacts documented at this site. The recent graffiti noted in February was brought to the attention of the National Park Service (NPS) archaeologist who was present on the May trip.

Recommendations

The plant transects at this site should be reinstalled in the presence of a trained botanist to establish a complete baseline for future monitoring.

MIXED PETROGLYPH - MONITORING SITE #2

This site contains petroglyph panels that are included in the SPC monitoring program. All tasks on the monitoring checklist were completed in May. Photo points were established. Photographs were taken at the established photo points and impacts documented at this site. No natural impacts were observed. Human impacts include trailing, which has increased dramatically since this site was visited in 1994. Visitors are presently entering the site from downriver and creating serious erosion on the steep bank which provides access to the bench below the panels.

Recommendations

The visitor impact at this site needs to be carefully monitored. Trail work is required to reduce the erosion near the site.

FERRY SWALE - MONITORING SITE #3

The plants at this site are included in the SPC monitoring program. In February, a segmented belt transect was installed at the upriver edge of the swale. The transect was reinstalled in May for rephotographing. There was no botanist present at either of those monitoring events, so the plant monitoring data are incomplete. There were no natural impacts observed at this site. Human impacts from the Test Flow included deposition of sand but no change in plant growth. Trash that had been washed down with the flood was collected from the beach. The transect was laid on a steep slope and cannot be monitored regularly without causing significant erosion on the slope.

Recommendations

The plant transect at this site should be reinstalled in the presence of a trained botanist to establish a complete baseline for future monitoring.

JACKASS CANYON - MONITORING SITE #4

The beach received a significant amount of sand deposition as a result from the Test Flow. Vegetation along the shore of the beach was impacted by the spike flow, but it is coming back well. This site is also affected by recreationists who can access the site by boat or by hiking in through Jackass Canyon. The vegetation near the hiking trail is impacted by visitors hiking from the canyon. During the May trip, debris was collected where it had accumulated near the bank of the beach.

Jackass Canyon is a primary training site for SPC monitors. Therefore, activities that were completed during the May trip were replicated in June. Monitoring tasks for the Southern Paiute monitors included re-installing a line transect running 66.85 m in length, rephotographing along the transect line, and doing a site evaluation. The monitors accomplished tasks that were outlined in the 1996 work plan. The only new impact between May and June was an increase in the amount of litter resulting from visitors hiking to the Colorado River through Jackass Canyon. Trash was recovered during the June monitoring trip.

Recommendations

This site should continue to be monitored annually. Special attention should be paid to the stability of the new beach, the health of the riparian plant community, and the encroachment of visitors into the upstream part of the beach.

SOUTH CANYON - MONITORING SITE #5

This site contains archaeological and rock art features which have been divided into 3 loci in the SPC monitoring program. During the Test Flow, the bank of the beach grew due to the sand deposition, making parts of the beach steep. Vegetation is sparse along the shore of the

beach. Sand was deposited into the mouth of the trail leading to the archaeology and rock art sites. With a little extra time on the May trip, monitors briefly visited Loci 1 and 2.

This site was visited but not monitored in June due to spiritual and ceremonial reasons.

Archaeology and Rock Art

Locus #1 includes 2 rockhouses which showed evidence of visitor impact during the May trip. There has been building up of a rock wall since last monitoring; at the last monitoring it was recorded as rocks falling from the walls of the houses. A collection of pottery sherds lies near the rock wall, and heavy trailing leads up to the rock houses. This locus was scheduled for complete monitoring during the June trip.

Locus #2 consists of three grinding areas and two rock art boulders. Photo points were established and the site map revised and updated. There was no evidence of significant natural impacts. A large collection pile of pottery sherds and rocks was seen lying beside a grinding area. Another collection of small colored rocks was placed on top of the rock art boulder. The area is heavily impacted by trailing. It appears visitors are straying away from established trails and therefore making new little trails. There is evidence of on site camping, and trash was found near the camping site. Objects have been moved since the last monitoring trip.

Locus #3 contained human remains and was not visited during 1996.

Recommendations

Archaeology and Rock Art monitoring of this site should be conducted in 1997. Trailing at this site should be reduced. Collection piles should be dispersed.

NANKOWEAP - MONITORING SITE #6

The river shore line at the mouth of little Nankoweap showed little change as a result of the Test Flow. Plants along the shore line are replenishing very well. The bank along Nankoweap Creek adjacent to the archaeological site located on the bench within the Colorado River floodplain has shown evidence of erosion since last monitoring. A minor flash flood, occurring since July 1995, has eroded sediment and large rocks from the bank and deposited them along the floor of the creek. This, in turn, has changed the course of the creek flow since the last visit.

June monitoring tasks for this site consisted of plant and archaeology elements. Plant monitoring was successful, but the archaeological features could not be located in the vegetative cover.

Plants

Three plant monitoring elements were established at Nankoweap in 1995, all located along Nankoweap Creek. The plot of plants that was established on the north side of Nankoweap

Creek approximately 150 m upstream from the river bank was visited and monitored in May 1996. There is evidence that trailing continues at the site. The area continues to be dry, allowing for very little plant growth. The brittlebush (*Encelia farinosa*) appears drought-stressed. Three individual cottonwood trees (*Populus fremontii*), located upstream along the creek were also visited; two of the trees which had been girdled by the 1994 flash flood in Nankoweap Creek died since the last monitoring, but the surviving tree was growing well. Therefore, the plants in selected plots and individual monitoring of three cottonwood trees were combined. Site maps and photo points were refined and updated.

The desert plant community of well developed prickly pear cactus (*Opuntia phaecantha)* continues to flourish. Among the abundance of cacti is an archaeological site which was not monitored although photos were taken of the site (see Archaeology).

Two plant monitoring elements were re-established at Nankoweap in June as part of the monitor training program. The first element was the selected plant plot with a 10 m radius. From the monitoring observations, plant number 2 (*Atriplex canescens*) and plant number 4 (*Encelia farinosa*) were dry and not in good condition. Plant number 8 (*Chrysothamnus nauseosus*) was in good health with one broken branch that will possibly be gone by next year.

The second element was a reinstalled line transect which ran 50 m in length from the river's edge. Several 2 X 2 m plots were established up to the 46 m point and the plots were rephotographed. The plants were not recorded (see Stoffle, Austin. Fulfrost, Phillips, and Drye 1995 for the plants included in those 2 x 2 m plots). Overview photos of the transect line were taken from the 40 m point to the end point (50 m) and to the starting point (0 m) of the transect.

Archaeology

A significant goal of the 1996 monitoring at Nankoweap was to integrate the plant and archaeological monitoring. This goal was only partially met; the site continues to require a great deal of time and effort, and adding new elements has not yet been possible. The former Paiute living area located on the lower bench just downriver of Nankoweap Creek was visited and photographed. The sand on the bench that supports a vigorous plant community was deposited by the pre-dam major floods. A BOR archaeologist was consulted on the May trip about the monitoring already being conducted there. Although the BOR monitors the site as a "non-eroding" site because of its relation to the Colorado River and Glen Canyon Dam, SPC monitoring photos show that there is active erosion from Nankoweap Creek at the edge of the site.

A second archaeology locus was identified for inclusion in the monitoring program prior to the June trip. However, none of the monitors present on that trip had previously visited the site, and the existing site map was insufficient to allow the monitoring team to locate the artifacts. Thick vegetative cover appears to be helping protect the archaeological features. The general location of the site and the overview of the area were photographed.

Recommendations

After consultation with the BOR archaeologist and a review of NPS monitoring plan, the monitoring program at Nankoweap should be modified to achieve the holistic monitoring required by the SPC. The impacts due to flash flooding in Nankoweap Creek are high, so Nankoweap Creek should be monitored again next year. The 50 m transect should be monitored yearly because the water level may impact the vegetation of the new high water zone (NHWZ). The individual plant monitoring should continue since some of the species were found not to be in good health. The archaeology units should be incorporated for further monitoring.

LAVA CHUAR - MONITORING SITE #7

This site was visited briefly during the Test Flow research, and photographs of the edge of the site were taken from the canyon floor. Erosion of the bank into Lava Canyon continues.

TANNER CAMP - MONITORING SITE #8

Monitoring tasks for this site consist of rock art monitoring and observation of the trailing leading up to the site. The beach located at this site has collected a significant amount of sand deposition building up the existing sand dunes and cutting a sharp embankment along the shore of the beach. This site contains archeological features consisting of rock art boulders located at the downstream edge of the beach on a narrow rocky ridge above a small side canyon. Erosion is occurring in the well established trail which is somewhat unstable in some areas.

Rock Art

This site includes six boulders with rock art and varnish. The May trip effort focused on establishing photo points to monitor the erosion along the trail leading to the rock art boulders.

All tasks on the monitoring checklist were completed in June. The photographs were retaken at the established photo points and impacts documented at this site. Natural impacts at this site consist of surface and direct water which are present, and mineral accretion which has increased since last year. The rain is eroding the petroglyph on the southwest corner of boulder #3 due to the placement of the rock. Human impact at this site consists of dust from foot traffic which is caused by the heavy trailing leading up to the site. The trailing is more visible this year than during the monitoring of July 1995 (see recommendations).

Recommendations

The 1995 monitoring report recommendation on trailing explains that there needs to be extensive trail work to reduce the heavy erosion at this site. The trailing is a major concern to the SPC monitors and the SPC again recommends that it receive attention by the Grand Canyon Park Service trail crew.

BEDROCK CANYON - MONITORING SITE #9

This site includes plants and archaeological features. All tasks on the monitoring checklist were completed in May. The photographs were retaken at the established photo points and impacts documented at this site. Evidence of sand deposition is present along the beach at the mouth of the canyon. The natural impacts at this site are minimal: there is only slight erosion of the bank of the wash with no evidence of drainage from canyon floor bed. There is increased foot traffic and trailing leading to the site. Trash was recorded as being found at this site, and beside the trash were fresh shoe markings.

Recommendations

Some of the trailing at this site has been attributed to past archaeological monitoring. The SPC should attempt to coordinate monitoring at this site with the NPS so the source of trailing at this site can be assessed and mitigation recommended. The SPC will also try to acquire aerial photos of this site to better understand its recent history.

DEER CREEK - MONITORING SITE #10 (M 136R)

The plants at this site were monitored in May. Upon arrival at the site, numerous boats were docked at mouth of Deer Creek, with significant numbers of tourists throughout the area. In the main part of the canyon near the falls, tourists were observed jumping into the water as well as swinging and hanging from ropes. Individuals were also observed picking and trampling plants for no apparent reason; in turn, the plants being picked were discarded. Rocks, both large and small, were also being thrown about.

June monitoring tasks for this site included rock art and visitor monitoring. The tourist traffic was again very heavy at the site, which provided the monitors a good opportunity to pilot the visitor monitoring forms that had been developed.

Plants

The established plant plots were relocated upstream from the chasm where the canyon widens into an open valley. A severe fire burned the above ground parts of plants in 1994, but most plants are regenerating vigorously. The severe drought that began in mid-1995 and has continued into 1996 has stunted the growth of the sacred datura (*Datura meteloides)* and has reduced the number of offsets on the *Agave* sp. by approximately one-third. The willow (*Salix exigua*) and cottonwood (*Popular fremontii*) are growing vigorously but show no new stems. The acacia (*Acacia greggii*) has sprouted new stems but is showing little vegetative growth.

Rock Art

The panels at this site have been designated A-N, with panel A starting the furthest away from the river and panel N the closest to the river. All monitoring tasks on the checklist were completed. The photographs were retaken at the established photo points and impacts

documented at this site. Also, a new site map was constructed. There were two new hand prints found that were not recorded in the 1995 monitoring documentation. The new hand prints are located directly across from panel L and directly across from panel I. These new hand prints are hard to find since one is only seen when the lighting in the canyon is not so bright and the other is at a certain part of the trail where it gets very narrow.

There seemed to be no new natural impacts since last monitoring (July 1995), but findings indicate that there have been human impacts since last monitoring. Graffiti was discovered on a flat rock across from panel A reading, "ZAK T - WAS HERE," and trailing is more visible on the west side of the canyon since the last monitoring.

Visitor Monitoring

As recommended in the September 1995 report (Stoffle, Austin. Fulfrost, Phillips, and Drye 1995), the SPC decided to establish a visitor monitoring program at this particular site, due to the large numbers of tourists that visit Deer Creek and the importance of this place in Southern Paiute culture. Visitor monitoring forms were filled out by the monitoring assistants who helped the SPC monitors fill out data forms throughout the 12 day June trip. The assistants were placed in pairs at different locations in the canyon to observe the hikers and boat tourist who entered and left the canyon. The assistants were disturbed by the actions from the visitors which included yelling, climbing down to the source of the waterfall, making a rude remarks, and urinating in the week.

Recommendations

Deer Creek is a very significant/spiritual place for the Paiute people, which means everything that is said and done there is of concern to the Paiutes. Observations recorded by SPC monitors indicate that the visitors do not have the same understanding of this site and what it means to Southern Paiute culture. The SPC recommends that a visitor and river guide education program be developed and implemented by the SPC, in conjunction with the NPS and the BOR, during 1997. The SPC recommends that visitor observations become a regular part of the monitoring program so the effectiveness of the education program can be assessed. For rock art monitoring, this site should be visited during the afternoon (see Stoffle, Austin, Fulfrost, Phillips, and Drye 1995).

KANAB CREEK - MONITORING SITE # 11 (MILE 143 R)

One monitoring unit, including plants and archaeology at this site, was monitored in May. That monitoring unit is located at the bend in Kanab Creek nearest the Colorado River and serves as a control point in the SPC monitoring program. That unit is above the influence of both the Colorado River and Kanab Creek. The remainder of the site was scheduled for June monitoring. The overall site evaluation records no change in the site condition from July 1995, aside from sand deposition along the beach shore. The creek leading to the river is still flowing. Although it is not very big, it leads to a small pool just above the river's edge.

The June monitoring visit to this site was canceled because on the evening of June 17, 1996 all the beaches above and at Kanab Creek were occupied. Therefore, the monitoring team could not monitor this particular site.

Plants and Archaeology

All monitoring tasks on the May checklist were completed. The photographs were retaken at the established photo points and impacts documented at this site. A 25 m line intercept transect was reinstalled at the site. The transect crosses vegetation, a small trail, and a rockshelter. Figure 1.1 shows the change in overall productivity along the transect between July 1995 and May 1996. The difference shown is not considered significant, especially because the 1996 data was collected earlier in the spring when plants within the Colorado River Corridor are at the height of their spring growing period.

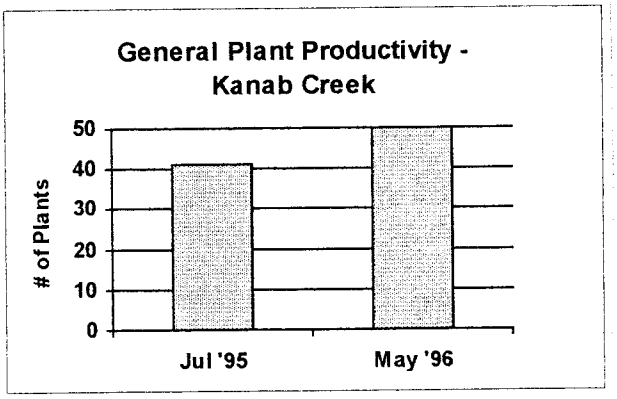

Figure 1.1. Change in overall plant productivity at Kanab Creek

Figure 1.2 shows the changes to each plant species found within the transect. Qualitative assessments at this site indicated the plants did suffer from a decrease in rainfall, especially the wire lettuce (*Stephanomeria exigua)* and globemallow (*Sphaeralcea grossulariaefolia*).

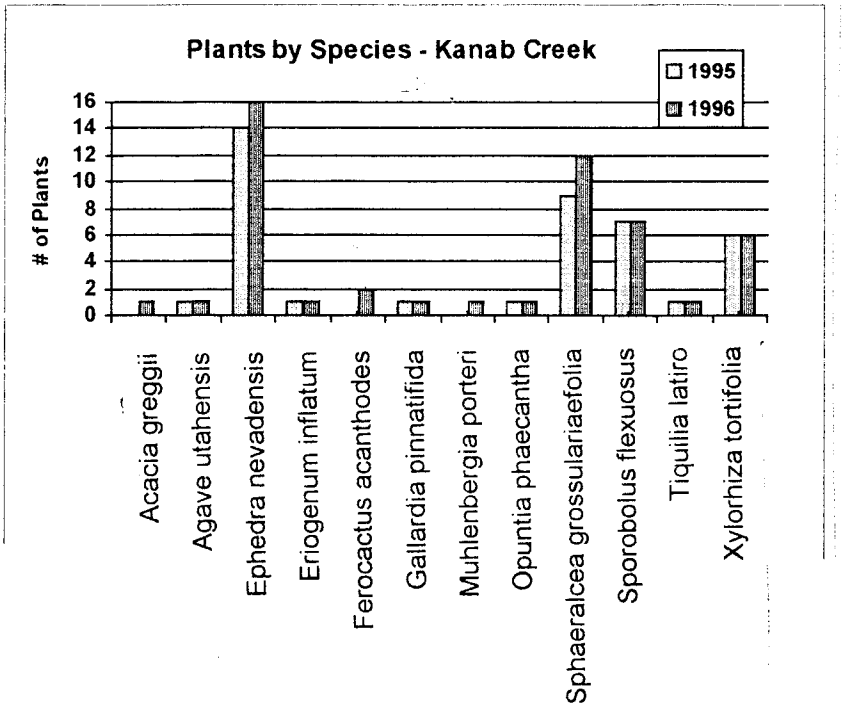

Figure 1.2. Changes to each plant species along the Kanab Creek transect

The other natural impact is slight natural erosion in the wash along the transect. Animal bones are eroding out of the bank. There is no evidence of increased bank slumpage. Human impacts at this site are restricted to trailing. A major trail leading past the site is well established, but this trail has little impact on the site. However, apparent straying from trail is also present. There is a smaller, less established trail beside the cliff wall near the archaeological features (rock shelter and grinding stone). The potential for investigator impact at this site is high.

Recommendations

It is recommended that the remaining monitoring units at this site be monitored in 1997. Additional transects located near the mouth of the canyon will provide a necessary means of evaluating the impact of the water release from Glen Canyon Dam on the site. The impact of monitors at this site is a serious concern, so it is recommended that some monitoring units be monitored only every 3-5 years to minimize walking on the slope near the site.

VULCAN'S ANVIL COMPLEX - MONITORING SITE # 12 (MILE 178-180 R & L)

The five loci at this site are described in the 1995 monitoring report (see Stoffle, Austin, Fulfrost, Phillips, and Drye 1995). Loci #1 and #5 were monitored in May. There is evidence of sand deposition upon the beach adjacent to the Anvil. In addition, bermuda grass (*Cynodon dactylon*) is growing abundantly. There is no evidence of visitor use at this site beyond a few footprints.

In June, the SPC only monitored three loci: #2, #3, and #4. The Anvil was visited for spiritual and ceremonial reasons only; no documentation was taken. On June 19, 1996 locus #2 and #3 were monitored and June 20, 1996 locus #4 was monitored.

Locus #1

This locus was monitored in May during the SPC Test Flow research. Results of the plant monitoring are reported in Austin and Osife (1996). The potential for investigator impact along the transect is high.

Locus #2

All monitoring tasks on the June checklist were completed. The photographs were retaken at the established photo points and impacts documented at this site. At this locus, surface and direct water erosion were observed, but they were not impacting the rock art or paint cave. There was a small stick poking out above rock shelter #2. Monitors were not sure if this stick was part of the site or if it was recently put there. A rock ball and remnants of rocks deposited under the pictograph were also observed in the middle of the site.

Locus #3

All monitoring tasks on the June checklist were completed. The photographs from July 1995 were retaken at the established photo points and impacts documented at this site. The impacts at this locus are reported to be from a natural state, and there is no sign of human impact since the previous monitoring (July 1995).

Locus #4

On June 20, 1996, locus #4 was monitored. The monitoring tasks on the June checklist were completed. The photographs were retaken at the established photo points, and impacts at the site were documented. A new site map was also constructed that indicated the photo points and location of this site. Natural impacts at this site were predominately the result of direct water and surface erosion. The only sign of human impacts is the trailing leading up to the site, which is not very visible.

Locus #5

In May, the monitoring photographs were retaken at the established photo points, and impacts at the site were documented. The line intercept transect installed at this site in 1995 could not be reinstalled because survey data needed for locating the transect endpoints was not available to the monitors on the May trip. Alternately, the surveyors located the entire exterior of the pond .The monitors recorded the continued increased growth of sawgrass (*Cladium californicum*) at this locus. In 1994, the sawgrass provided a natural barrier to its features. However, in May 1996, the monitors recorded a well-established trail leading through the sawgrass that provides easy access to the locus. There is evidence of tourist visitation as a collection of four round rocks were

placed on a low ledge near the rock art site. An increase in bullrush (*Scirpus* sp.) within the pond area was also observed.

Recommendations

Loci #1, 2, and 3 should not be fully monitored every year because there are no major natural or human impacts occurring here and there is the potential for impacts from monitors, such as sand erosion and soil compaction at these locations. The Anvil itself should continue to be monitored to record any type of articles that may be thrown on it. In addition, when the beach adjacent to the Anvil is visited, the lower end of the transect at locus #1 should be reinstalled so the post-Test Flow growth of the bermuda grass (*Cynodon dactylon*) can be monitored. Locus #4 should be monitored every other year for natural impacts and human impacts. Because of the increase in use of the trail leading to locus #5, the locus should be monitored again in 1997. In addition, it is recommended that the SPC obtain aerial photographs of the pond at locus #5, digitize the images, and incorporate the information into the Geographic Information System (GIS) component of the monitoring program (see Chapter Three). Measurements of the change in sawgrass (*Cladium californicum*) and giant reed (*Phragmites australis*) can be compared with data collected in the field. The SPC should also investigate the concerns of other cooperating agencies, such as the Hualapai Tribe and NPS, at this site.

WHITMORE WASH - MONITORING SITE #13

The beach upriver from the main trail leading to the pictograph panel at this site was monitored in May. A 36 m line intercept transect was located by surveyors, plant monitoring was accomplished, and photos were taken. The monitors located the approximate location of the he transect reference points without the assistance of the surveyors by extrapolating from the remaining shoreline on either side of the newly deposited beach, but the surveyors were required for exact relocation of the transect. Increased sand and vegetation were measured along the beach shore, providing improvement to the site (see Austin and Osife 1996; Appendix B). There is evidence of trailing to the upper part of transect location, although the trailing is not heavy and the beach shows very little visitor impact.

The June monitoring tasks at this site were primarily focused on the trailing to and in front of the large panel and the paint cave.

Archaeology and Rock Art

The monitoring tasks on the June checklist were completed. The photographs were retaken at the established photo points, and impacts at the site were documented. The findings that were recorded seem to be the same as last year (see Stoffle, Austin, Fulfrost, Phillips, and Drye 1995). There do not seem to be any natural impacts to the panel, but the dust which is caused by visitors walking near the panels seems to continue to have an effect on the already damaged trail. There is no sign of natural impacts present at the paint cave. Photographs from the

previous monitoring (July 1995) were compared by the June monitoring team, and there were certain rocks moved from the cave.

Recommendations

This site is a concern to the SPC since it is a heavily visited site, and there is a large amount of graffiti. Visitors who do not understand the importance of this site and the significance it has to Southern Paiute culture may then think it is okay to vandalize even more. In the future, the SPC recommends establishment of some sort of pilot visitor monitoring program (See Deer Creek- Visitor Monitoring). Better pictures of the paint cave should be taken in the next monitoring of this site. The plant monitoring at this site should be re-evaluated in an attempt to establish a monitoring program not dependent on surveyors.

PRE-PARASHANT - MONITORING SITE #14

This site was monitored in May during the Test Flow research (see Austin and Osife 1996; Appendix B). There were no significant changes in the condition of the bank at this site since the 1995 monitoring. However, there was a significant increase in trailing leading to the rock art panel, damaging some vegetation. Trailing along the side of the panel had also increased. The mesquite trees previously protecting the site had been cleared back, allowing easy access to the site. The monitors recorded black charcoal markings near one rock art drawing that were not recorded in 1995. The vegetation surrounding one roasting pit area has increased since last monitoring. A 35 m line transect was reinstalled. The transect endpoints were located by surveyors and corresponded with those located by the monitors using photodocumentation.

OMPI CAVE - MONITORING SITE #15

This site was visited for spiritual and ceremonial reasons, but monitoring involved only visual inspection. Natural erosion from the main cave was observed.

Recommendations

The SPC should evaluate its monitoring plan for this site in 1997.

SPRING CANYON - MONITORING SITE #16

An increase sand deposition was evident in May, showing improvement to the riverbank at the canyon mouth. The floor of Spring Canyon has shown a significant amount of increase in vegetation, especially in wild tobacco (*Nicotiana trigonophylla*).This increased growth in vegetation has changed the course of the creek, as noted through comparison with 1995 monitoring photos.

Monitoring of rock art, plants, and the rockshelter was completed. The twelve line intercept transects that crisscross the creekbed down the wash to the mouth of the river were reinstalled in May 1996 (see Austin and Osife 1996; Appendix B). The monitors also relocated

and monitored the selected plant plot. During a reconnaissance of the creekbed, the monitors observed significant plant growth since July 1995. They recommended that remote photographic monitoring of the archaeology feature be installed in June to avoid creating a trail to the rockshelter.

In June, the monitoring team rephotographed the plants in selected monitoring plots because of a camera failure at this site in May. The monitoring team also completed the archaeology and rock art monitoring at this site, according to the May recommendations.

Plants

The monitoring tasks on the May checklist were completed (see Austin and Osife 1996). GCES surveyors are required to relocate the transect endpoints.

In June, photo documentation was completed for the selected monitoring plots. Refer to Stoffle, Austin, Fulfrost, Phillips, and Drye (1995) for the table of the selected plants. In general, the wild tobacco (*Nicotiana trigonophylla*) was observed to be suffering, presumably from the drought. Several of the plants within the plot died between July 1995 and 1996. One new wild tobacco plant was observed growing inside of the wall of the rock art site.

Rock Art

In May, the Rock Art site did show evidence of new mineral accretion on the wall near the paintings. Although natural erosion has been occurring throughout the years and diminishing the appearance of the rock art, no new erosion was observed. The site is surrounded by dense vegetation which has increased in growth, but evidence of trailing to this particular site still exists. A small terrace upstream of the panel provides access to the site. Bank slumpage is a problem at the mouth of the trail where visitors access the site from the canyon floor. Use at this location may be heightened because the previous work by the NPS trail crew has camouflaged the downstream trail from the canyon floor to the rock art site, discouraging visitors from entering from that direction.

In June, the missing monitoring photographs were retaken at the established photo points, and impacts at the site were documented. The only natural impact that was present was the eroding bank along the edge of the creekbed. This is a natural impact from the wash that flows by at the location of a former trail leading up to the rock art panel. A new trail that has been created upstream from the former trail is already experiencing significant erosion. It is impacted more when there are floods. No other human impacts at the site were noted.

Archaeology

In May, the decision was made to monitor the rockshelter from the base, since the trail that existed since 1994 had become covered with new plant growth. The monitors elected not to re-create trailing to the site, thus encouraging natural protection there. The plant protection is

viewed by the SPC monitors as a positive impact. In June, the monitors established several remote photo points to monitor the vegetation and any future trailing that may occur.

Recommendations

In the future, the rockshelter should continue to be monitored from the base. The rock art panel should be monitored in the evening since the lighting on the panel is less bright and the photography is most effective then. The twelve transects should be monitored in a multiyear cycle in coordination with surveyors.

INDIAN CANYON - MONITORING SITE # 17

This site encompasses an archaeology site with three roasting pits to the north of the site and one large roasting pit located in the center of the site. This site also includes a rockshelter with several historical mason jars; underneath the rock shelter there are various Ompi figures. This site was monitored in June.

Rock Art

In addition to the written documentation, photos were taken. Surface erosion and mineral accretion were observed at this site. Human impacts include the trailing up to and around the site.

Archaeology

Photographic documentation was completed. The trail work by the National Park Service trailing crew was intended to divert visitors to a single trail, but the monitors noted that the trail leads straight through the large roasting pit. The field report shows that surface erosion to the structures, artifacts, roasting hearths, and perishable midden is present. Gullying through the roasting/hearth is present.

Recommendations

Additional vegetation monitoring on the beach and the mouth of the canyon is needed because there is heavy impact from camel thorn and bermuda grass. The monitoring photos must be retaken. The SPC should consult with the NPS regarding the trail that leads through the roasting pit at this site.

PUMPKIN SPRING - MONITORING SITE #18

This site was monitored in May. All monitoring tasks were accomplished. Sand deposition along the bank of river increased during the Test Flow. Trailing to the spring and camping on the beach area continue. The black markings from boat visitation are visible on the edge of the spring itself. The Test Flow cleansed the spring of old mineral deposits and algae. This was perceived to be a positive impact by SPC monitors.

ADDITIONAL SITES MONITORED

Ledges Springs - (M 151R)

This site is located above sandstone ledges where a large roasting pit is present. At this site, there is an abundance of plant life that is significant to the Paiute people. Photo documentation was completed and a site map and monitoring form begun. One elder was interviewed about the plant life that was present at the site.

It is recommended that the roasting pit and plants that are significant to the Paiutes be monitored for natural and human impacts during 1997.

Cove Canyon - Upstream Site (M 174R)

This site is located near the mouth of Cove Creek. The SPC monitoring team visited the site and established overview photo points. The site should be evaluated for full incorporation into the SPC monitoring program, including a review of NPS monitoring reports and discussion with Paiute cultural experts.

Summary and Conclusions

The SPC monitoring program was firmly established during 1996. The SPC monitoring forms were modified between the May and June trips, as discussed above. The new forms were easier to use than the previous ones. In addition, a site-specific monitoring checklist was developed for each site prior to the trip. The checklist reduced the time required for completing the work and prioritized what was to be done at each site. Checklists and monitoring forms should be prepared by the SPC monitoring team at least one month in advance, as outlined in the project manager's guidebook. The monitoring transects were standardized so all begin away from the river and run toward it. Although this adjustment required additional time for analysis during 1996, it will reduce error in future data collection and analysis. The Tribal Monitor Training Program was developed and field tested (see also Chapter Two). The plant reference guide was created with the assistance of the project botanist and will benefit the monitoring program. The guide has been incorporated into the SPC multimedia database and archival system so it can be used for training as well as field identification (see Chapter Three).

The primary new tasks of the 1997 SPC monitoring program include (1) further integration of the field data with the Glen Canyon Environmental Studies GIS (GCES-GIS; see Chapter Three); (2) further integration of the program with work being done by other agencies, especially other tribes, the BOR, and NPS; (3) expansion of the monitoring training program to include GIS and data archiving; and (4) incorporation of previously archived data into the current program. The SPC program serves the special needs of the governments of the Kaibab Paiute Tribe and Paiute Indian Tribe of Utah (PITU) and the resource management agencies of the United States.

CHAPTER TWO

ENVIRONMENTAL EDUCATION

The 1996 Southern Paiute Consortium *Colorado River Corridor* Environmental Education Program was adapted from the 1995 program. As recommended in the report of the 1995 program (see Stoffle, Austin, Fulfrost, Phillips, and Drye 1995), the 1996 program included two phases. Phase One included 10-15 year olds participating in learning experiences and a three-day field trip. Phase Two included high school youth and included (1) introductory activities and a three-day monitoring and study trip (the Lees Ferry trip), (2) a twelve day river trip (the downriver trip), (3) a six day trip to the University of Arizona (the multimedia and GIS learning project), and (4) oral and written reports to the leaders and members of the involved tribes. Both phases of the program will be further refined during the 1997 program (see Recommendations).

Program Activity Discussions

The Lees Ferry Trip

Summary of Activities

The Lees Ferry trip took place from May 29-31, 1996. The trip included the Phase One and initial Phase Two activities and occurred in conjunction with the Southern Paiute Consortium's post-flood upriver monitoring trip (see Osife and Austin 1996). The trip was initially scheduled for four days, to include (1) one day at the North Rim of the Grand Canyon, with stops at the overlooks for Nankoweap and Unkar Delta and an introduction to the regional ecosystem that includes Southern Paiute aboriginal territory and the Colorado River Corridor, (2) one day at House Rock Valley, with an introduction to Paiute history and its relation to cultures as defined by archaeologists, and (3) two days at Lees Ferry, with an introduction to Southern Paiute monitoring, the history of the Glen Canyon Dam, and the management of the lands presently under the jurisdiction of the National Park Service. The trip was reduced to three days and included an overnight camp at Jacob Lake but no visit to the North Rim or House Rock Valley because the unpaved roads in these areas were closed due to fire danger. The trip schedule and activities are shown in Table 2.1. Trip participants included the SPC Coordinator, the educational specialist, a research assistant, a tribal monitor, and eight youth. Transportation to the sites upriver from Lees Ferry and information about the GCNRA and the controlled flood were provided by a Glen Canyon National Recreation Area archaeologist.

Two days were spent at Lees Ferry as planned, and the activities were successfully completed. Due to an unforeseen limitation in the number of participants who could go upriver on the NPS boats, the younger participants were split into two groups. One individual was able to visit all the monitoring sites and participate in the activities there. Three other youth and the SPC Coordinator were only able to visit one site during the trip. As a result of the Lees Ferry

experience, the educational specialist developed a monitor training program to be incorporated into the downriver trip (see below).

Recommendations

The only Phase One activities were carried out during the Lees Ferry trip. In addition, the initial activities of Phase Two of the Environmental Education Program occurred at this time. These activities were abbreviated due to the drought conditions on the Colorado Plateau during the spring of 1996. It is expected that in future years these activities can be carried out as planned. These activities should take place in conjunction with the annual upriver monitoring trip.

Phase One of the Southern Paiute Consortium *Colorado River Corridor* Environmental Education Program received only minimal attention in 1996 due to the considerable requirements of conducting research related to the March-April controlled flood from Glen Canyon Dam (see Osife and Austin 1996). A comprehensive Phase One will ensure that in the future participants in the remaining phases have a solid base upon which to build their knowledge. This is especially true with the introduction of a multimedia and GIS component in the remaining program phases. Thus, Phase One should receive careful attention in 1997. Also, every effort should be made to ensure that all Phase Two participants participate in these initial program activities.

The Downriver Trip

Summary of Activities

The downriver trip took place from June 12-23 and occurred in conjunction with the Monitoring Trip (see Chapter One). The education component of the trip included (1) specialized training in monitoring skills and techniques, (2) direct information about Paiute culture provided by elders and tribal leaders, (3) experiential learning in Paiute traditional practices and in monitoring activities, and (4) instruction in scientific concepts related to the Colorado River and the canyons through which it flows. A monitor training program, consisting of nine individual and group activities, was developed and used for the first time on the downriver trip. The tribal elders were an integral component of the education program, sharing information about past as well as present connections between Southern Paiutes and the Colorado River Corridor. The education program was fully integrated into the monitoring program, and the trip schedule and activities is provided in Table 2.2. Trip participants include two elders, the SPC Coordinator, two monitors, seven youth participants, an educational specialist, and a research assistant. Transportation was provided by OARS.

Table 2.2. Downriver Trip Schedule and Education Component Activities

Date	Site	Activities Completed
June 12	Jackass Canyon	Monitor Training Activities #1-4
June 13	Jackass Canyon	Monitor Training Activities #5-6 Elder Presentation - Ethnobotany & Resource Management
June 13	South Canyon	Paiute Cultural Transmission
June 14	Nankoweap	Assist Monitors - Archaeology and Vegetation Elder Presentation - Monitor Training Activity #9
June 16	Tanner	Assist Monitors - Rock Art and Trail Elder Presentation -
June 17	Deer Creek	Visitor monitoring Paiute Cultural Transmission
June 18	Ledges Springs	Assist Monitors - Archaeology Elder Presentation - Ethnobotany
June 19	Cove Canyon	Using Site Maps to Locate Sites
June 19	Vulcan's Anvil	Monitor Training Activity #7
June 20	Vulcan's Anvil	Assist Monitors - Archaeology
June 20	Whitmore Wash	Assist Monitors - Rock Art Elder Presentation - Ethnobotany & Hunting Paiute Cultural Transmission
June 21	Ompi Cave	Paiute Cultural Transmission
June 21	Spring Canyon	Assist Monitors - Plants and Rock Art
June 22	Indian Canyon	Assist Monitors - Archaeology and Rock Art Elder Presentation - Resource Management
June 23	Diamond Creek	Take out

The downriver trip was a great success. The critical elements of this successful program are: (1) active participation of tribal elders who accompany youth to culturally significant sites and share traditional knowledge with them; (2) active participation of tribal monitors who work directly with youth to complete monitoring activities and share information about the cultural

significance of the sites; (3) a monitoring training program specifically tailored to the needs of Southern Paiute monitors; and (4) active participation of an educational specialist with experience in , and environmental/outdoor education and knowledge of environmental policy and the cultural, social, and political history of the area. Each of these elements enhances the entire program so program participants receive a comprehensive education about the region impacted by the Glen Canyon Dam.

For example, during the evening circle that was incorporated into the 1996 program, participants would be informed about the significance of sites that are to be monitored the following day. Elders and monitors told stories about the places and explained the culturally appropriate behavior expected there. All participants discussed what they knew about the places and shared their feelings about visiting them. The Consortium Coordinator and educational consultant provided additional information about other groups and historical/political events related to the places, as requested. The evening ended with a time for prayer and reflection. After breakfast the following day, the trip participants would take out their river guides and notebooks to review the stops of the previous day and look ahead to the coming one. Prior to entering any site, the trip leaders would gather the participants together and help prepare for any ceremonies or ritual practices appropriate to the situation. At a site, some youths would remain with the elders to listen to stories and information the elders wanted to share. Other youths would assist the monitors as they recorded the condition of the site. At large and complex sites, the monitors would divide into two or more teams to gather all the necessary information in a timely manner. All participants gathered together again at the end of the monitoring tasks.

Trip participants demonstrated their mastery of the skills needed for monitoring by taking greater responsibility for the monitoring tasks as the trip progressed. In addition, participants and non-participants completed an activity designed to measure the impact of the trip on participants' knowledge of the Colorado River Corridor. As shown by the two examples provided in Figure 2.1, trip participants were able to represent detailed knowledge of significant Southern Paiute places along the Colorado River that non-participants were unable to represent.

Recommendations

Due to the limited number of individuals who can participate in a river trip and the need to maintain a fairly rigid schedule of travel to arrive at the take-out point on time, the successful monitoring and education program requires careful logistical preparation. First, *the selection of participants is critical.* Two elders are needed so they can complement one another's knowledge, share and confirm information with one another, and take turns climbing to difficult places. Also, two monitors are needed to accomplish the multiple tasks needed at each site and provide support for one another. Another individual must take responsibility for the trip's itinerary, updating and refining the schedule as needed, and maintaining communication among group members. Finally, the students must be aware of the difficulties of working in the Colorado River Corridor and must be prepared for the experience through participation in pre-trip study and events. The success of the June 1996 trip can be attributed to the appropriate inclusion of knowledgeable and dedicated individuals.

Second, the *program participants must have sufficient opportunities to learn skills needed for the trip and to practice those skills*. During the May trip, the students were introduced to the monitoring program, the history of the Glen Canyon Dam, the issues surrounding the involvement of tribal, state, and federal agencies, and the differences between the Glen Canyon Recreation Area and the Grand Canyon National Park. Students also helped set up and maintain an outdoor camp. During the June trip, the students were divided into three teams: (1) monitor assistants; (2) elder assistants; and (3) cook assistants. The students rotated partners and job assignments throughout the trip so they could work with all the other participants and experience all the jobs. Due to the unexpected addition of an extra trip cook, the cook assistants frequently had little to do. It is anticipated that this will not occur on future trips, so this organizational structure should be continued.

Third, *all trip participants must be kept informed of the daily schedule and tasks*. Each participant was provided with a trip schedule and a river guide for recording the day's events and looking ahead to the next day's activities. This practice should be repeated in the future. Still, due to the uncertainty of camp sites and the changing conditions of the river environment, the schedule changed frequently. During the second day of the trip, the Consortium Coordinator and tribal monitors organized a meeting to discuss some events that had occurred at one site. At that time, the group decided to hold an evening circle prior to bed each night to review events of the day and discuss the following day's activities. The evening circle proved to be a very successful part of each day during which site and cultural information was shared, emotions were expressed, and social skills were developed. Regular meetings are recommended for future trips as well. Additional group meetings were also held as requested by any participant feeling a need to share something with the group.

The Multimedia and GIS Learning Project

Summary of Activities

The addition of the multimedia and GIS learning project to Phase Two was a tremendous achievement for 1996. This aspect of the program provides a critical link among experiencing a place, collecting information about it, and storing that information so it is accessible to decision makers. The project took place from July 14-19 at the University of Arizona. The project schedule is shown in Table 2.3. The UofA provided project participants access to computers, training, and knowledgeable faculty and staff. Project participants stayed in dormitories on the university campus and participated in activities that were designed to enrich their understanding of broad environmental and Native American issues as well as the specific Southern Paiute concerns in the Colorado River Corridor.

Project participants worked in pairs to enter monitoring data into a relational database that has been developed by the UofA ethnographers for use in conjunction with the multimedia database. They also helped create and update a computerized catalog system for monitoring photos and scanned photos for incorporation into the multimedia database. Project participants were introduced to Geographic Information Systems (GIS) and participated in lessons designed to familiarize them with the concepts underlying a GIS. They also observed some of the layers

Table 2.3. Southern Paiute Consortium Colorado River Corridor Monitoring and Environmental Education Program - Schedule for University of Arizona July 14-19, 1996

Date	Time	Activity	Location
July 14		Arrive at the UofA campus	
	7-8	Dinner	UofA Food Services
	8-10	Tour of UofA	Campus
July 15	7-8am	Breakfast	UofA Food Services
	8-8:30	Tour of BARA	317A Anthropology
	8:30-10	Intro to Computers	120 Anthropology
	10-12	The SPC Database	Geron. 122
	12-1pm	Lunch	UofA Food Services
	1-3	Intro to Internet	UofA Science Library
	3:30-5:30	Swimming (youth)	Recreation Center
		Database info (monitors and Coordinator)	Geron. 122
	6:30-10	Barbecue	Stoffle's House
July 16	7-8am	Breakfast	UofA Food Services
	8-12	Work on SPC database	Geron. 122 & 317A Anthropology
	12-1pm	Lunch	UofA Food Services
	1-3	"Paths of Life" Exhibit	Arizona State Museum
	3:30-5:30	Swimming (youth)	Recreation Center
		Report preparation (monitors and Coordinator)	317A Anthropology
	6-7	Dinner	UofA Food Services
	7-10	Out on the town	Tucson
July 17	7-8am	Breakfast	UofA Food Services
	8-9:45	Work on SPC database	317A Anthropology
	10-11	Native Americans on campus	Native American Resource Center
	11-12	Tour of UofA library	UofA Main Library
	12-1	Lunch	UofA Food Services
	1-5	Work on SPC database	Geron. 122 & 317A Anthropology
	6-7	Dinner	UofA Food Services
	7-10	Movie	Tucson
July 18	6:30-7:30	Breakfast	UofA Food Services
	8-12	Native Plants	Native Seed Search
	12-1	Lunch	UofA Food Services
	1-5	Work on SPC database	Geron. 122 & 317A Anthropology
	5:30-6:30	Dinner	UofA Food Services
	7-10	Visit Museum and Laser Show	Flandreau Planetarium
July 19	7-8am	Breakfast	UofA Food Services
	8-1pm	Work on SPC database	Geron. 122 & 317A Anthropology
	1-3	Lunch	Local Restaurant
		Return home	

within the GCES GIS. Unfortunately, they were unable to integrate the SPC data with the other GCES GIS data because that information has not yet been processed by the GCES and made available to the SPC or the UofA.

While at the UofA, the SPC monitors also worked with the UofA ethnographers to begin analysis of monitoring data and finalized the trip reports for the 1996 river trips associated with the monitoring and education program.

The work begun at the UofA was continued into August at the SPC offices on the Kaibab Paiute Reservation. Through a youth job training program, the Kaibab Paiute Tribe was able to hire several of the youth who participated in the Colorado River Corridor Environmental Education program to work in the cultural resources program. These youth assisted in the preparation of the SPC annual reports to the BOR by creating and updating the photo catalog system, transcribing tapes made on the river trips, and serving as office assistants.

Recommendations

The addition of the multimedia and GIS learning project to Phase Two was a tremendous achievement for 1996. This aspect of the program provides a critical link between experiencing a place and collecting information about it and creating a means to store that information and make in accessible to decision makers. The integration of computer training, data entry, and interaction with other Native American groups proved to be very successful. In addition, the continued link between project activities and "real" work was central to the continued participation of the students. In her evaluation of the project, one student wrote, "[The job I enjoyed most in working on the database is:] inserting the work I helped do. It made me feel good."

The program relied heavily on resources of the University of Arizona that were made available to the program at little or no cost to the SPC. The project generated a very positive response within the university community, so it is expected that it can continue to be an element of the overall program. The university can provide access to many computers at the same time to facilitate both learning and data entry. Therefore, it is recommended that the multimedia and GIS learning project continue to take place at the University of Arizona, even after the SPC program computer equipment is moved to the Kaibab Paiute Reservation.

Oral and Written Reports

The final element of Phase Two is the presentation of findings, in oral and written form, to the tribal governments and members of the Kaibab Paiute and Shivwits Paiute Tribes. Tribal meetings were held August 15 at the Shivwits Paiute Reservation and August 16 at the Kaibab Paiute Reservation. Education program participants were involved in both presentations. Presentations included slides, oral reports, and a question-and-answer period. In addition, a booklet containing the participants' written reports was produced and distributed to tribal members.

Recommendations

Like in 1995, this element of the program was important for bringing closure to the 1996 program and served to inform tribal council members, families, and friends about the participants' experiences in the program. The ongoing success of the SPC monitoring and education program depends on the continued support of the program from throughout the involved tribes. Trip participants expressed a desire to have more people involved in the program. For example, when asked how to improve the program for next year, one individual wrote, "Just try to get more people involved. Like our Paiute people- elders, adults, and especially youth." The tribal presentations and the duplication of the participant reports for distribution to any interested tribal members are an important means of communication within the tribes.

Summary and Conclusions

The 1996 SPC Environmental Education program utilized the recommendations provided in 1995 to modify the initial program to better serve the needs of the involved tribes and the BOR. The program is an important component of the SPC monitoring program and is offered in conjunction with regularly scheduled monitoring activities whenever possible. Thus, the program provides considerable benefit and requires few extra resources.

A major focus of the 1997 program will be the integration of GIS education and training for monitors and program participants (see also Chapter Three). One of the unique program features is the use of multimedia and GIS databases to link culturally significant stories and beliefs, direct field experiences, and scientific data. This aspect of the program will be further developed and enhanced in 1997.

CHAPTER THREE

ARCHIVING DATA: THE SOUTHERN PAIUTE CONSORTIUM MULTIMEDIA DATABASE AND ARCHIVE

Over four years of participation by the Southern Paiute Consortium (SPC) in the Glen Canyon Environmental Studies (GCES) has produced an enormous amount of data documenting Southern Paiute cultural and natural resources in the Colorado River Corridor. This information is contained in text-based surveys, photos, audio tapes, maps, and video. The ongoing Southern Paiute cultural resource monitoring program also produces a large quantity of still images and text-based monitoring data (see Chapter One). This data, existing in so many different media types and formats, requires a specialized archival system that can efficiently store, retrieve and link together this valuable cultural information. A digital multimedia database and archive was selected as the means of providing easy access to the vast array of cultural information collected as part of the GCES Southern Paiute cultural resource studies. The function of this computer based multimedia archive is threefold: (1) make information about Southern Paiute cultural resources in the Colorado River Corridor available to the Southern Paiute cultural resource monitoring program; (2) provide an educational tool for the SPC; and (3) provide an efficient and easy way to archive and retrieve information. This chapter describes the initial development of the SPC multimedia database and archive and explains the selection process for both hardware and software components.

Obtaining Hardware and Software

The first step in developing the database was selecting computer hardware and software that would be capable of fulfilling the goals of the database and archive. Although the goals of any project often change as the project develops, it is important to be as clear as possible from the beginning about the intended function of the database (i.e., the goals to be achieved by its creation) as well as how it potentially will be utilized by the end user, the SPC. Because hardware and software are interdependent, they will be considered together in this section.

Both IBM-compatible personal computers (IBM-PC compatibles) and Macintosh computers have the capability to create a multimedia database. Macintosh computers are more effectively designed for processing images, such as photographs, and for integrating various media types, such as combining audio with images, video and text. However, over the last few years, IBM-PC compatibles have gained the capability of doing the same types of multimedia operations with the design of new microprocessing chips (the Pentium) and new operating systems (Windows95 and Windows NT). Also, access to technical support services for Macintosh computers in remote areas such as the Kaibab Paiute Reservation is limited, owing to the pervasiveness of IBM-PC compatibles in business and government. For these reasons a decision was made early on to develop the multimedia database and archive utilizing IBM-PC compatible hardware and software.

The Computer

The technical requirements of the computer purchased for the development of the multimedia database and archive were driven by the physical requirements of transforming different forms of media (i.e., photos, audio, video, and text) into digital formats that could be utilized by the computer. Processing and integrating images, audio, video and text (i.e. multimedia) on a personal computer (PC) requires a number of hardware devices in addition to the main computer. In addition, the chosen computer components had to meet the requirements of the selected software programs.

Scanning photos and capturing audio and video from cassettes and then manipulating them on a computer requires a system that can efficiently process and store this information. This efficiency is determined by the technical specifications of the computer itself. As a result, a "high-end" computer was required. The specification of the computer that was purchased are as follows: a Pentium microprocessor running at 166 megahertz, 48 megabytes of Random Access Memory (RAM) for image processing, a SCSI harddrive with 2 gigabytes of storage space, 512K cache, numerous expansion ports, and a 17 inch Super VGA monitor (allowing adequate space for image processing). The selection of hardware was made in conjunction with software selection to ensure an optimally functioning system. For example, quick and efficient manipulation of images using software such as Adobe Photoshop, requires a lot of memory; 32 megabytes of RAM at the minimum. Consequently, the computer system was purchased with 48 megabytes of RAM. Complete technical specifications of the computer purchased for this project can be acquired directly from the SPC.

The SPC required a PC manufacturer who could provide a cost-effective computer system that fulfilled all the technical requirements for multimedia development and also had excellent technical support. After comparing a number of companies, Gateway 2000 was chosen because of both cost-effectiveness and extensive technical support.

Peripheral Devices

Many different peripheral devices are needed to transfer still images (i.e. photos), audio, and video into digital files that can be stored and played on the computer itself. In order to capture video from a cassette and transfer it to the computer a *video capture board* was required. Intel's Video Recorder Pro is an industry standard and the most commonly used device for transferring video onto a PC. Creative Lab's Soundblaster cards are the most commonly used and supported *audio cards* on the market. For this reason, the Soundblaster AWE 32 plug and play was chosen to capture audio off the cassettes and transfer it to the computer.

Transforming photos into digital images requires the use of *a scanner*. A flatbed scanner was determined to be best suited for the SPC project because it combines ease of scanning and low error. Many companies manufacture flatbed scanners, the two most prominent being Hewlett-Packard and Microtek. Microtek's E6 model was selected because it can scan at a high resolution and could be purchased at a lower cost than comparable Hewlett-Packard machines. In addition,

at the time of purchase, the E6 was bundled with a full version of Adobe Photoshop, the image processing software that would be used to save and manipulate the photographs being scanned. Finally, the Microtek scanner received many good reviews in popular computer magazines.

A *color printer* was also required to (1) make color prints of monitoring photos in house for use in assessing the condition of monitoring sites while in the field, and (2) produce hard copies of the database itself for use in cultural resource training and educational programs. The initial cost of color laser printers is very high (over $1000) and replacement ink cartridges for these type of printers are also very expensive. Although the image quality is not as good, many color inkjet printers on the market produce relatively high quality images at a much lower cost. For this reason, a Hewlett-Packard Deskjet 855Cse was chosen because it could be purchased for under $500, its ink cartridges were reasonably priced, and it can print relatively high quality images at up to 600 dots per inch (dpi). Hewlett-Packard is also the leading manufacturer of computer printers and has an excellent performance record.

The final hardware device that was required for the multimedia database/archive was a *file storage device* that could store large quantities of data. This is particularly necessity because scanning large quantities of photos and video requires enormous storage capacity. Even with a 2 gigabyte hard drive, some form of external drive was required that could be used as a storage archive for the image, audio, video, Geographic Information System (GIS), and other database files. The *Iomega Jazz Drive* provided an ideal solution because its read/write speed is far ahead of any other tape drive or CD-ROM and each cassette can store up to 1 gigabyte of information. The only disadvantage with this Iomega Jazz Drive is the price of the cassettes, which retail for around $115 dollars apiece.

Software Programs

Data from Southern Paiute research and monitoring in the Colorado River Corridor have been stored in several computer databases. In 1996, one of the UofA ethnographers developed a relational database for the monitoring data using Microsoft Access. Additional data necessary for the monitoring program is generated in ESRI's ArcInfo. A major goal of the SPC database/archive is to make all the data accessible through one multimedia program. Nevertheless, a number of different software packages are needed to effectively accomplish multimedia development on a computer.

The most important software program of a multimedia project is the one used to actually combine the different forms of media (i.e. digital images with audio and video files) and create the database/archive itself. Asymetrix's Multimedia Toolbook CBT Edition (version 4.0) was chosen for this purpose. The program uses the metaphor of a book for developing or "authoring" a multimedia application. The concept behind developing applications in Toolbook is relatively simple, and a well renowned Toobook developer at the University of Arizona provided and will continue to provide on-site technical support to the UofA team and the SPC.

For proeessing digital images, no other software program really compares to Adobe Photoshop, the industry standard. This program was acquired in a package purchase with the Microtek scanner. The software used to both capture and manipulate audio files was provided by the manufacturer of the sound card itself (Creative Labs). This software package is more than adequate to suit the needs of including audio into the database/archive. Similarly, the software included with the video capture board was more than adequate to suit the needs of both capturing and editing the video itself. In fact, this software package, entitled Digital Video Producer, is not only an Asymetrix product, and therefore compatible with the Toolbook program, but is also extremely user-friendly.

Problems and Issues with Hardware and Software

Despite a considerable investment of time spent researching the various hardware and software components of the SPC multimedia database/archive, numerous problems required attention during the initial development phase in 1996. The most time-consuming and pervasive problem was configuring the hardware devices so that they were compatible with each other. Adding the video capture card, audio card, scanner, and Jazz drive to the computer purchased from Gateway 2000 proved to be extremely problematic. Inadequate time was allotted for configuring the interrupt, I/O and SCSI addresses of each hardware device so they would not conflict. The plug and play Bios included with the Gateway 2000 and the plug and play feature of Windows 95 were unable to properly identify and configure non-plug and play devices such as the Intel Smart Video Recorder Pro. In addition, Intel's ISA Configuration Software that was included with the Soundblaster AWE 32 plug and play required that an extra expansion port that had been included with the sound card and that was conflicting with other hardware devices be disabled. These problems consumed much of the work time of the UofA team member in charge of developing the database.

Getting and Utilizing Support Services

The UofA database developer utilized many human and physical resources located at the University of Arizona (UofA). This support included access to the staff and computer equipment located at the Multimedia and Visualization Lab, regular consultation and troubleshooting assistance from a Toolbook developer in the Biomedical Communications Department, and extensive guidance and technical assistance from the System Administrator of the Anthropology Department. The wide-ranging experience and expertise of the UofA faculty and staff proved to be invaluable in the development of the database.

While trying to configure each hardware device to be compatible, the UofA database developer utilized the technical support phone services provided by each individual manufacturer. However, the technical support personnel at one company did not necessarily know appropriate information for configuring their products with the hardware devices of other manufacturers. As a result, considerable time was spent by the UofA developer explaining the features of the various devices to the technical support personnel.

Recommendations

Although the hardware and software components of a multimedia database are interdependent and must be considered together, there are separate issues surrounding each of them. For this reason, a separate person should be in charge of maintaining the hardware than the person responsible for software development. Also, if purchasing computer equipment for a future multimedia project, the SPC should consider buying a complete "multimedia" system in which all the peripheral hardware devices are pre-installed and pre-configured by the computer company itself (i.e., Gateway 2000).

Design and Implementation of the Database/Archive

The initial phase of development of the Southern Paiute Colorado River Corridor multimedia database/archive was accomplished in 1996 in two steps. The first step involved a team of individuals from the SPC and the UofA who participated in the design of the database, selection of elements such as text and photos to be included, and the generation of new components. The vast majority of the information in the database/archive was generated during the research on Southern Paiute cultural resources in the Colorado River Corridor between 1992 and 1996 (see Stoffle, Halmo, Evans, and Austin 1994; Stoffle, Loendorf, Austin, Halmo, Bulletts, and Fulfrost 1995; Stoffle, Austin, Fulfrost, Phillips, and Drye 1994). Therefore, the first step involved both researchers who had collected the data and student researchers who made the data available in the formats required for the database/archive. As the data was identified and prepared for inclusion in the database/archive, missing elements were noted and plans made to obtain them. For example, the team determined that overview photos of each place included in the database/archive were needed to orient users to each place. Therefore, participants in the June monitoring trip were assigned places to photograph, in addition to their other research tasks. Similarly, after an inventory of plant photos was completed, the project botanist was given a list of plants needing to be photographed for inclusion in the database/archive. The botanist took the photos during the May trip when this task was combined with the creation of a plant reference guide (see Chapter One).

The second step of the initial development phase involved (1) the creation of the database/archive structure to achieve the design objectives identified in step one, and (2) placing data in the database/archive by scanning photos, capturing audio and video, downloading maps, and inserting text. This step was carried out by the UofA database developer with the help of student assistants. Major tasks in this step include toolbook programming and multimedia database design, image processing, program management/coordination, archive and database development, and ArcView programming. The UofA developer required knowledge of many different computer programs, including image processing, toolbook programming, and audio and video capture, and experience with database design and archive development. The creation of the database also necessitated some knowledge of graphic design and layout to produce a Graphical User Interface (GUI) that would be easy to understand and visually pleasing.

A file naming system was created for the scanned photographs and digitized audio files. This system provides an easy way to reference these digital files according to a number of

appropriate indexes (i.e., Monitoring Site, type of cultural resource, date, etc.). However, complete documentation and indexing of existing photographs, audio tapes, and video tapes would facilitate further development of the multimedia database/archive through the transfer of these data to digital formats.

Multimedia Database/Archive Outline

The Southern Paiute Colorado River Corridor multimedia database/archive is organized into six main sections: Overview, Cultural Landscape, Index, Paiute People, Stories, and Culture Change. The core of the database consists of text and photographs that were produced from the Southern Paiute cultural resource studies conducted between 1992 and 1995. Information regarding the cultural significance of plants, animals, archaeological sites (including rock art) and sacred sites forms the backbone of the database and can be accessed from anywhere in the database. Users can also access information about Southern Paiute places in the Colorado River Corridor via a list or a map from anywhere in the database. Separate pages devoted to Southern Paiute elders and others involved with the Colorado River Corridor research and Southern Paiute stories related to the region will complete these "building blocks."

Each section of the database provides the user an opportunity to access cultural information about the Southern Paiute connection to the Colorado River Corridor via a different "avenue". During 1996, the Overview and Cultural Landscape sections were completed. The Overview Section contains a slide show of pictures and text that summarize the cultural resource studies and the monitoring and education programs.

The Cultural Landscape Section provides geographic access to cultural information about Southern Paiute Places and the cultural resources found at each place in the Colorado River Corridor via maps of the region. The user is first shown a satellite image of the region that has been identified as the Grand Canyon Regional Landscape (Stoffle, Austin, Fulfrost, Phillips, and Drye 1995). As the user scrolls over the image with the mouse, areas relating to the appropriate 1:250,000 USGS quadrangle maps are highlighted. Each quadrangle is then further divided into six sections indicated by purple boxes. When the user clicks on these purple boxes she is taken to another page of the database that displays the section of the 1:250,000 USGS quadrangle map that was highlighted by the purple box. Southern Paiute places found within these map sections are shown as red dots. A user can click on these dots to be taken to another page containing cultural information regarding these places and the Southern Paiute cultural resources found there. These Southern Paiute place pages contain links to other pages containing more cultural information about each specific cultural resource.

Education and Training

The database/archive was designed for use by the Southern Paiute Consortium as an educational and training tool as well as a permanent archive of Southern Paiute cultural knowledge about the Colorado River Corridor.

Educational programs for Southern Paiutes can be created that incorporate the database/archive. The database can serve as a training tool for new tribal members participating in the cultural resource programs of the SPC. They can utilize the database/archive to understand about cultural perceptions and uses of plants, animals, and archaeology sites. They can also learn about the cultural significance of Southern Paiute places in Colorado River Corridor. Individuals can also use the database to read and listen to the Paiute language and learn about Southern Paiute culture in the Colorado River Corridor. Worksheets and learning modules can be developed that require the use of the database. These education programs can be incorporated into the existing environmental education project (see Chapter Two). For example, during their annual oral presentations to the tribe, participants can demonstrate that they can pronounce and understand Paiute words they learned from the database.

Future Development and Recommendations

Further development of the database would be best implemented by a team, with each task the responsibility of a different person. Unexpected problems, such as hardware conflicts, often occur when working with computers. It is therefore best to have different people responsible for different tasks, so problems with one area do not prevent workers in other areas from accomplishing their goals.

The numerous keywords, pictures, and maps that link the different sections of the database together provide tribal members a wide variety of ways to access and discover information about their cultural heritage. A complete alphabetical Index of these keywords, pictures and maps will be an invaluable addition to the database/archive. Unexpected technical problems occurred during the attempt to build both full-text and keyword search capabilities into the database. Including these search capabilities into the database is a priority for future development.

Other priority additions to the database include: (1) a complete set of audio files of the Southern Paiute names for plants and animals; (2) a complete set of scanned pictures for each plant, animal, archaeology site, ecozone page, monitoring site, and Southern Paiute place; (3) a listing on each plant page to Southern Paiute places where the plant can be found; (4) brief text describing each picture; (5) pages devoted to Southern Paiute elders; and (6) small video segments at each Southern Paiute Place. In addition, for each Southern Paiute place that is also a Southern Paiute Monitoring Site, links are needed to the appropriate Microsoft Access reports and ArcInfo coverages contained in the Monitoring Database. Finally, there should be access in the multimedia database itself to the complete set of scanned monitoring photos.

In 1997, a complete inventory of all elements of the SPC database/archive should be created and the missing components prioritized for acquisition. Those elements that can be obtained during the annual monitoring trip should be identified and included in the 1997 schedule.

In 1995, the SPC worked with GCES surveyors to incorporate certain monitoring sites into the GCES GIS (see Stoffle, Austin, Fulfrost, Phillips, and Drye 1995). Little of that information has been made available to the SPC. The SPC should work to obtain that information

in 1997 so it can be used to link monitoring and cultural resource data in ArcInfo to the remainder of the multimedia database/archive.

Southern Paiute tribal members have expressed interest in using the database/archive for educational purposes. The addition of Southern Paiute words, phrases, and texts will require special efforts for proper reproduction and translation. A working dictionary and reference grammar must be developed to facilitate transcription and translation. From those, learning modules can be developed and incorporated into the database.

The SPC multimedia database/archive contains invaluable information about Southern Paiutes that is required by federal land managers as well as tribal members. In addition, the international status of the Grand Canyon brings millions of visitors to the region each year. Protection of cultural resources depends in large part on the cooperation of non-Paiutes. A goal for 1997 is the development of a public education module using data from the database/archive. The SPC will also explore various modes for providing access to the module, including CD-ROM and the Internet.

Summary

The SPC multimedia database/archive is one means by which the SPC can meet its long term data storage and retrieval needs. The initial phase of development brought numerous challenges, but these challenges were successfully met. The database/archive will be further developed in 1997.

CHAPTER FOUR

SUMMARY AND CONCLUSIONS

This report has summarized the results of the 1996 Southern Paiute Consortium (SPC) Colorado River Corridor Monitoring and Environmental Education program. The 1996 program had three major goals: (1) modification and implementation of the Southern Paiute Consortium's monitoring program; (2) education and training of Southern Paiute monitors and teenage youth; and (3) initial development of an archival program and multimedia database. All of these goals were accomplished during 1996.

The addition of outside resources made it possible for the SPC to expand its monitoring and education program to incorporate more tribal members in more tasks than in 1995. For example, the program received support from the Kaibab Paiute Job Training (JTPA) and the donation of faculty and staff time, equipment, space and facilities at the UofA. The SPC will continue to seek opportunities to supplement BOR resources with funding and in-kind contributions to ensure the long term success of its monitoring and education program.

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Appendix A
Southern Paiute Consortium Tribal Monitors Training Program

Objectives of Southern Paiute Consortium Tribal Monitors Training Program Activities

Activity #1:

Objective: Participants will demonstrate that they can use a magnetic compass to locate objects on a map.

Activity #2:

Objective: Participants will demonstrate that they can use a site map and compass to locate items in their environment.

Activity #3:

Objective: Participants will demonstrate their ability to complete photo logs, including (1) photo point number, (2) photo number, (3) description of object being photographed, and (4) compass reading of object in relation to photo point.

Activity #4:

Objective: Participants will demonstrate their ability to replicate photographs using a site map, recording information on a photo log, and matching existing photos.

Activity #5:

Objective: Participants will demonstrate their ability to read a metric tape measure and to estimate distance in meters and centimeters.

Activity #6:

Objective: Participants will demonstrate their ability to read a transect line using a metric tape measure.

Activity #7:

Objective: Participants will demonstrate their ability to observe and experience a place, including the interactions going on among other living things there.

Activity #8:

Objective: Participants will demonstrate their ability to record their observations of visitor behavior.

Activity #9:

Objective: Participants will demonstrate their ability to read and interpret topographic maps.

Appendix B
Southern Paiute Consortium Study of the Impacts of the 1996 Glen Canyon Dam Beach/Habitat-Building Test Flow

SOUTHERN PAIUTE CONSORTIUM STUDY OF THE IMPACTS OF THE 1996 GLEN CANYON DAM BEACH/HABITAT-BUILDING TEST FLOW

Diane Austin and Cynthia Osife
for the Southern Paiute Consortium
August 16, 1996

Introduction

The Glen Canyon Dam Beach/Habitat-Building Test Flow (hereafter referred to as "Test Flow") was implemented in 1996 as part of the long term management program established by the Glen Canyon Dam Environmental Impact Statement. Among the objectives of the Test Flow is to protect cultural resources (USDI 1996). The Southern Paiute Consortium (SPC), on behalf of the Kaibab Paiute Tribe and the Paiute Indian Tribe of Utah (PITU), conducted research to evaluate the effects of the Test Flow on cultural resources located within the region impacted by water flowing at 45,000 cfs. The SPC Test Flow research fulfilled the following four objectives: (1) ethnobotanical monitoring; (2) additional cultural resource monitoring; (3) beach monitoring; and (4) monitoring of the impact on the SPC program. This report has been organized with one section devoted to each of these objectives. The report concludes with a summary and recommendations for the future.

Ethnobotanical Monitoring

Southern Paiute cultural resources located in the Colorado River Corridor within the region impacted by water flowing at 45,000 cfs include: plants, animals, minerals, archaeological sites, and traditional cultural properties (TCPs). Prior to loss of control of the resources within this region, Southern Paiutes visited the area annually, planting and harvesting their gardens, gathering food and medicinal resources, and conducting ceremonies, all necessary for their continued survival and well-being (see Stoffle, Halmo, Evans, and Austin 1994; Stoffle, Austin, Fulfrost, Phillips, and Drye 1995; Stoffle et al. 1995). The banks of the Colorado River provide habitats for plants and animals that have high cultural significance for Southern Paiute people (see Stoffle, Halmo, Evans, and Austin 1994). Therefore, any changes to these areas and the resources they support require careful monitoring. The objectives of the 1996 Test Flow included *preserving and restoring camping beaches, reducing near-shore vegetation and providing water to old high water zone vegetation* "without significant adverse impacts to cultural resources (Wegner, Stevens, and Melis 1995:2). The SPC research study evaluated the impact of the Test Flow on culturally significant plants and animal habitats within the old and new high water zones.

H_{01}: The Test Flow will not impact the plants that are culturally significant to the Southern Paiute people.

H_{A1}: The Test Flow will impact the plants that are culturally significant to the Southern Paiute people.

Methods

The impact of the Test Flow on culturally significant plants and animal habitats was evaluated at nine sites that are included in the SPC Monitoring program (see Table 1). Baseline data on seven of the sites was gathered in 1995 (see Stoffle, Austin, Fulfrost, Phillips, and Drye 1995). The first and second sites were visited during February 1996.

Table 1. Ethnobotanical Monitoring Sites

Site Name	Method of Monitoring	Baseline Year
Glen Canyon Petroglyph	Belt and Line Transects, Photography	1996*
Ferry Swale	Belt Transect, Photography	1996*
Jackass Canyon	Belt Transect, Photography	1995
Nankoweap	Belt Transect, Selected Plots, Photography	1995
Bedrock Canyon	Selected Plots, Photography	1995
Vulcan's Anvil	Line Transect, Photography	1995
Whitmore Wash	Line Transect, Photography	1995
Above Parashant	Line Transect, Photography	1995
Spring Canyon	Line Transect, Photography	1995

*Pre-Test Flow monitoring completed in February 1996

Each of the nine sites was visited between May 8-22, 1996. As shown in Table 1, ethnobotanical monitoring included nonpermanent and permanent measures at each site. Nonpermanent measures included qualitative assessments of the level of impact due to erosion, flooding, and the presence or absence of river-based streams. Permanent measures included photography, belt transects, line intercept transects, and selected plot monitoring. Changes in human impacts to all sites, as influenced by changes in the beaches due to the Test Flow, were evaluated during the SPC regular monitoring program June 12-23, 1996.

Results

The impacts of the Test Flow on the plants within each monitoring site were determined by combining the results of the various methods. Each site is discussed separately in the following sections. Some change in plant productivity is to be expected between 1995 and 1996 because the 1995 data were collected in July, after the spring growing season, and the 1996 data were collected in May, at the end of the spring growing season. Minor changes (<20%) are attributed to season variation and measurement error.

Glen Canyon Petroglyph. A 50m segmented belt transect was installed from the talus slope above the Colorado River to the shoreline. The transect crosses the steep bank between the river and a trail that runs perpendicular to the river. The upriver monitoring team did not include a botanist, so qualitative assessments of vegetative growth were recorded during February and May to assess the impact of the Test Flow. The Test Flow deposited sand along the beach below the site and inundated the beach up to the steep bank. Significant plant growth was observed along the beach, especially an abundance of mustard (*Thelypodium* sp.).

Ferry Swale. A 50m segmented belt transect was installed along the upriver edge of the swale from the desert slopes to the Colorado River shoreline. The upriver monitoring team did not include a botanist, so qualitative assessments of vegetative growth were recorded during February and May to assess the impact of the Test Flow. The Test Flow deposited sand along the beach at the lower end of the transect, but there was no significant change in plant growth.

Jackass Canyon. A 85m segmented belt transect with discontinuous 2 x 2m subplots was reinstalled from the Colorado River shoreline to the upper part of the beach at the base of the talus slope. The transect passes from the lower beach area with young willows (*Salix exigua*) through a high dune area with abundant ricegrass to the back of the delta with an intermittent line of hackberry (*Celtis reticulata*). Figure 1 shows the change in overall productivity along the transect between July 1995 and May 1996. Figure 2 shows the changes to each plant species found within the transect. The quantitative assessments of the site and photographs taken at 10m intervals along the transect indicate that the plants at the site received little impact from the Test Flow. Qualitative assessments were made of two plant species, tamarisk (*Tamarix chinensis*) and coyote willow (*Salix exigua*), which do not appear in the transect but are present at the site. The tamarisk was little affected by the flood. The stems of the willows within the flooded area had been broken off and were vigorously resprouting.

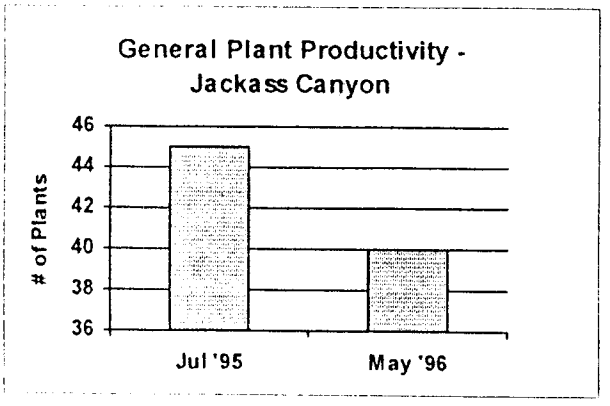

Figure 1. Change in overall plant productivity

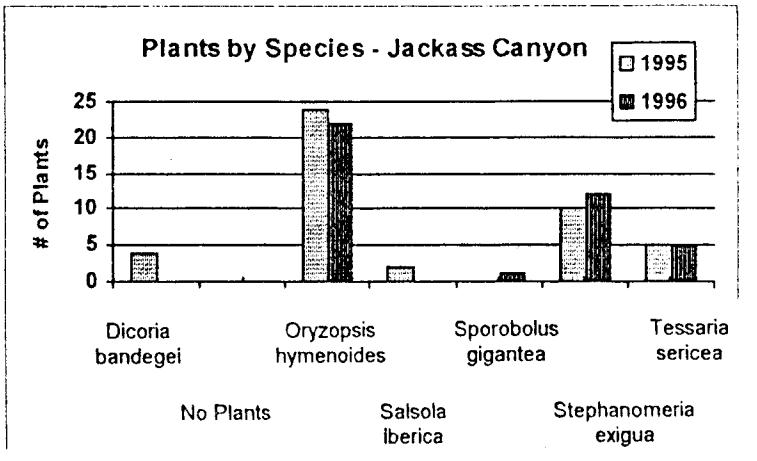

Figure 2. Changes to each plant species

Nankoweap. A 50m long segmented belt transect 2m wide was reinstalled perpendicular to the Colorado River immediately downriver from Nankoweap Creek. The transect runs across the new high water zone and enters the old high water zone. Plants in the portion of the transect nearest the river include riparian species that are impacted by both the Colorado River and flash flooding from Nankoweap Creek. Plants in the upper portion of the transect are part of a stable community of grasses and shrubs typical of the upper beach zone. Figure 3 shows the change in overall productivity along the transect between July 1995 and May 1996. Figure 4 shows the changes to each plant species found within the transect as shown, a significant portion of the increase in plants between 1995 and 1996 was the increase in horsetail *(Equisetum hiemale)*, willow (*Salix exigua)*, and tamarisk (*Tamarix chinensis)*. Only *Equisetum laevigatum* showed a significant decrease in number of plants. Figure 5 shows the change in productivity within the area impacted by the Test Flow (Lower) and outside that area (Upper). Both quantitative and qualitative assessments of the site and photographs taken at 10m intervals along the transect indicate that the culturally significant plants were impacted by the Test Flow. Plants within the flooded area were vigorously growing and sprouting.

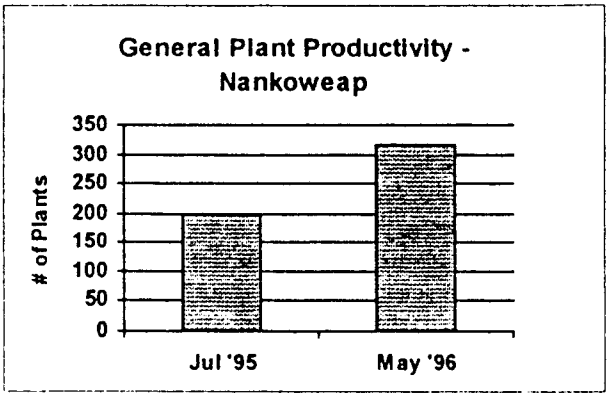

Figure 3. Change in overall productivity

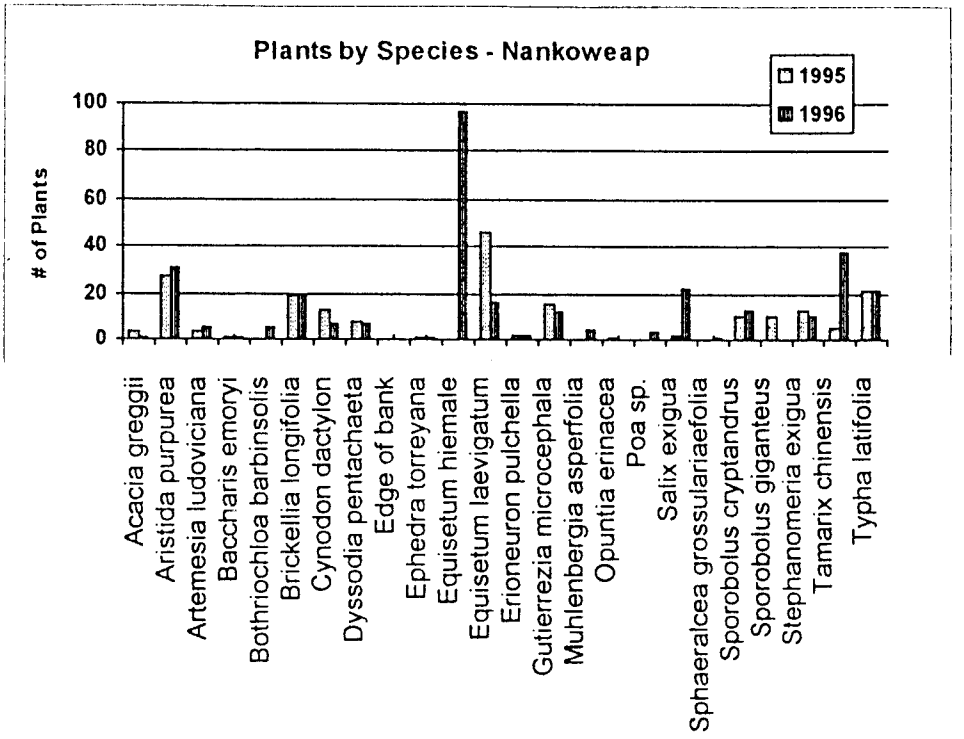

Figure 4. Changes to each plant species

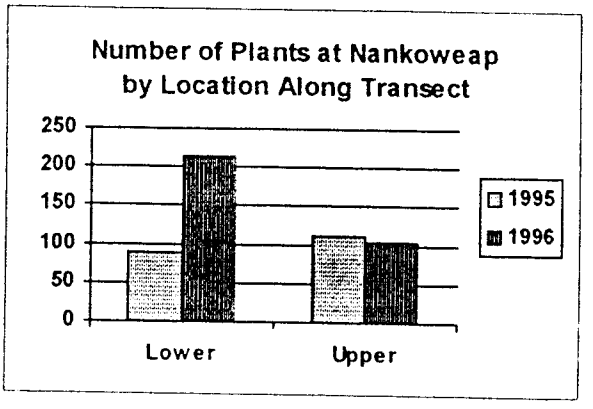

Figure 5. Changes in productivity due to Test Flow

Bedrock Canyon. A selected plant monitoring plot was reestablished at Bedrock Canyon. The Indian tea *(Ephedra nevadensis)* and barrel cactus (*Ferocactus acanthodes)* plants within the plot were in good condition at the time of the May visit; the acacia *(Acacia greggii)* was in fair condition. These plants were not impacted by the Test Flow.

Vulcan's Anvil. A 35m line transect was reinstalled on the right bank of the Colorado River near Vulcan's Anvil. The transect starts at a large conglomerate boulder located at the river shoreline and ends in a large creosote bush in the lower portion of the talus. Figure 6 shows the change in overall productivity along the transect between July 1995 and May 1996. Figure 7 shows the changes to each plant species found within the transect. Qualitative assessments of the site and photographs taken at 5m intervals along the transect indicate that the plants at this site received little impact from the Test Flow.

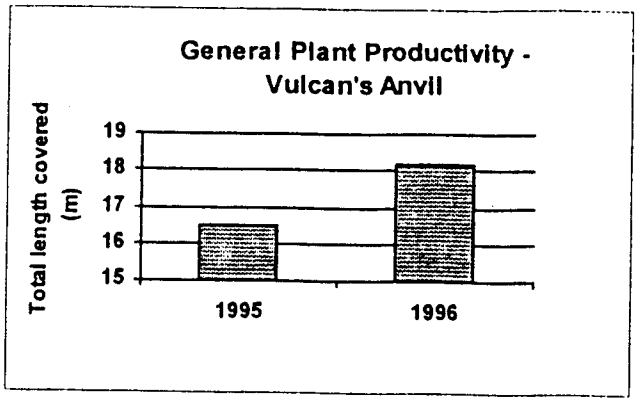

Figure 6. Change in overall productivity

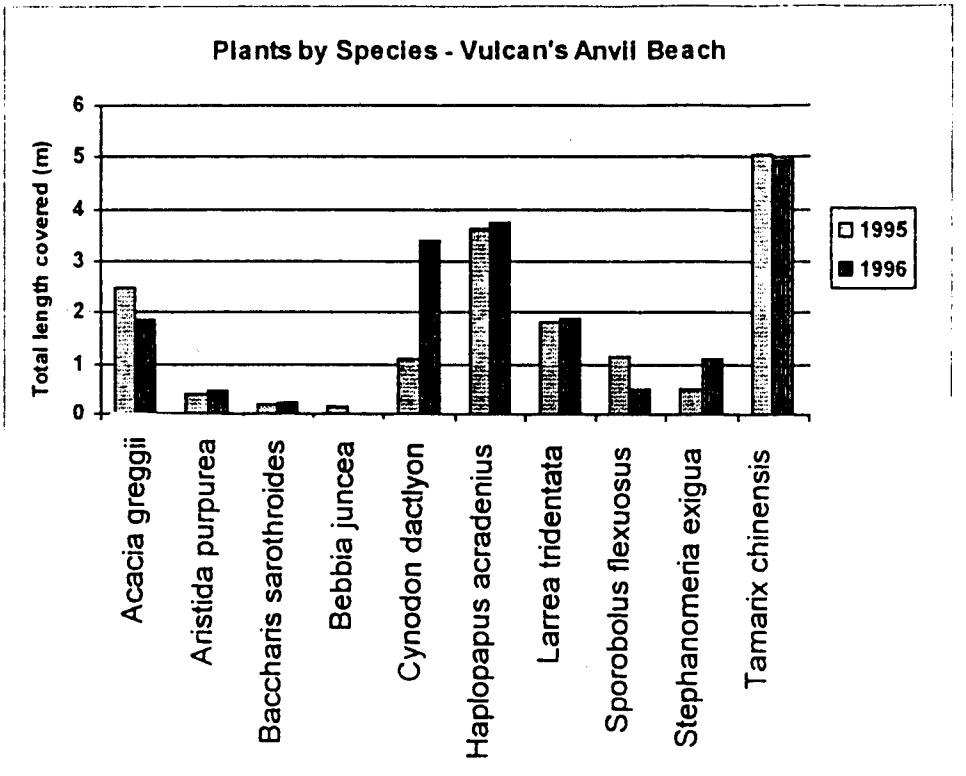

Figure 7. Changes to each plant species

Whitmore Wash. A 36m line transect was reinstalled in the riparian and beach vegetation upriver from the main trail leading to the pictograph panel at Whitmore. The transect passes through dense vegetation and runs from the shore to the upper beach at the high water line from the 1983 flood. Figure 8 shows the change in overall productivity along the transect between July 1995 and May 1996. Figure 9 shows the changes to each plant species found within the transect. Figure 10 shows the change in productivity within the area impacted by the Test Flow and outside that area. Qualitative assessments of the site and photographs taken at 10m intervals along the transect indicate that the site received significant impacts from the Test Flow. The lower end of the transect was completely submerged in sand.

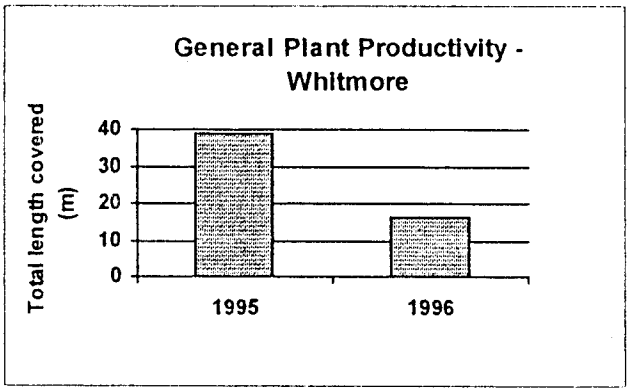

Figure 8. Change in overall productivity

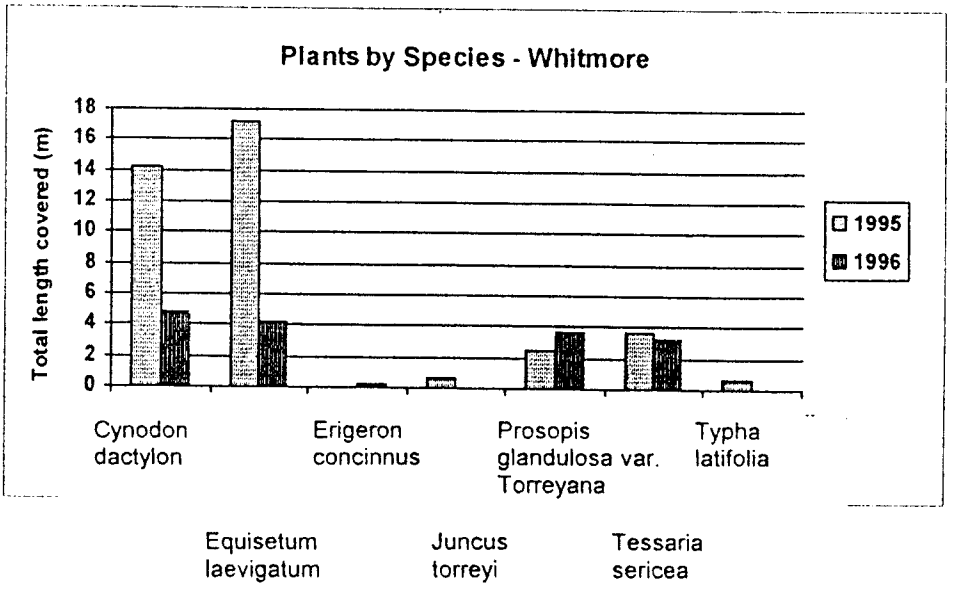

Figure 9. Changes to each plant species

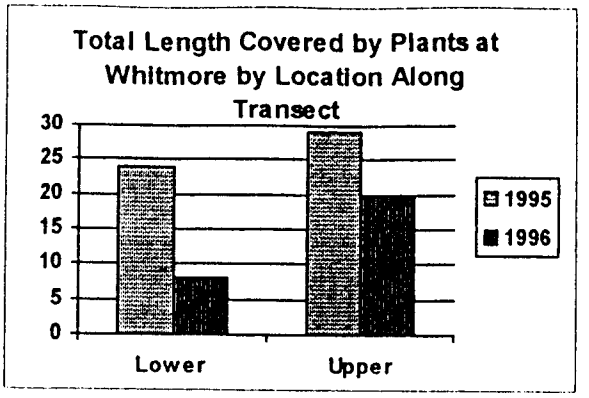

Figure 10. Changes in productivity due to Test Flow

Above Parashant. A 47m line transect was reinstalled beginning at the Colorado River shoreline and running to the lower edge of the mesquite-acacia zone. The transect was extended to the rock wall immediately downriver of the rockshelter to ensure that it could be relocated in the future without the assistance of surveyors (see Monitoring the Impact on the SPC Cultural Resource Program below). Figure 11 shows the change in overall productivity along the transect between July 1995 and May 1996. Figure 12 shows the changes to each plant species found within the transect. Qualitative assessments of the site and photographs taken at 10m intervals along the transect indicate that the plants at this site received little impact from the Test Flow.

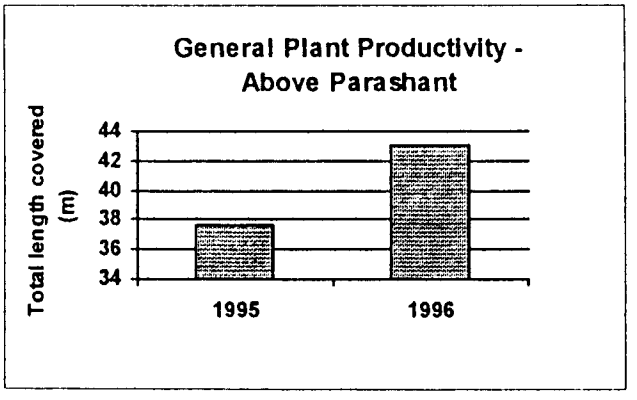

Figure 11. Change in overall productivity

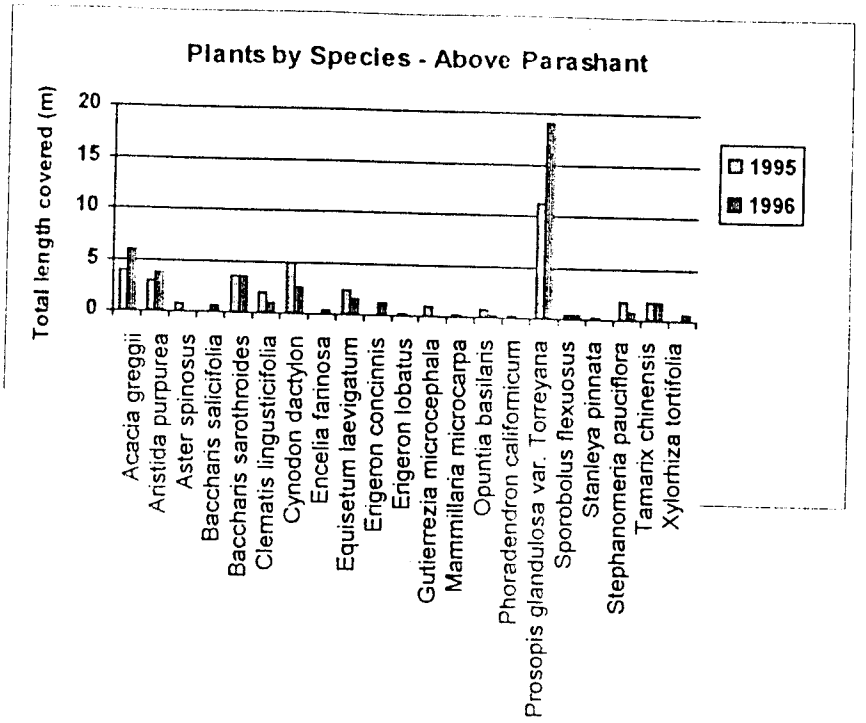

Figure 12. Changes to each plant species

Spring Canyon. Eleven transects were installed across Spring Canyon beginning upstream of the rockshelter and continuing to the Colorado River. Five of these transects were located within the area impacted by the Test Flow. The most dramatic change in Spring Canyon is the revegetation occurring within the creek bed following the flash flooding that occurred there in March 1995. The upper region of the canyon, where surface water is present, is showing tremendous recovery from the flood. The lower region, where the flood damage from the 1995 was the greatest, has shown little recovery since July 1995. The changes along the line transects within the area impacted by the Test Flow can be compared with those changes along transects falling outside the impacted area.

Plants were monitored along only five of the eleven transects in 1995, so the change in overall productivity along the transects between July 1995 and May 1996 shown in Figure 13 records data from only transects 1, 4, 6, 8, and 10. Data from all transects were added together to create these summary figures. Figure 14 shows the changes to each plant species found along the transects. Figure 15 compares the change in productivity within the area impacted by the Test Flow with that outside that area.

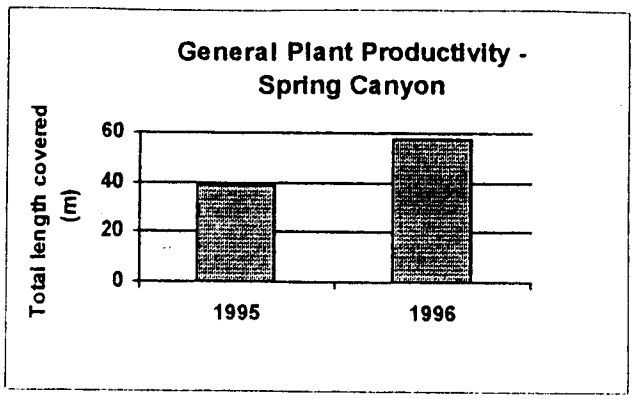

Figure 13. Change in overall productivity

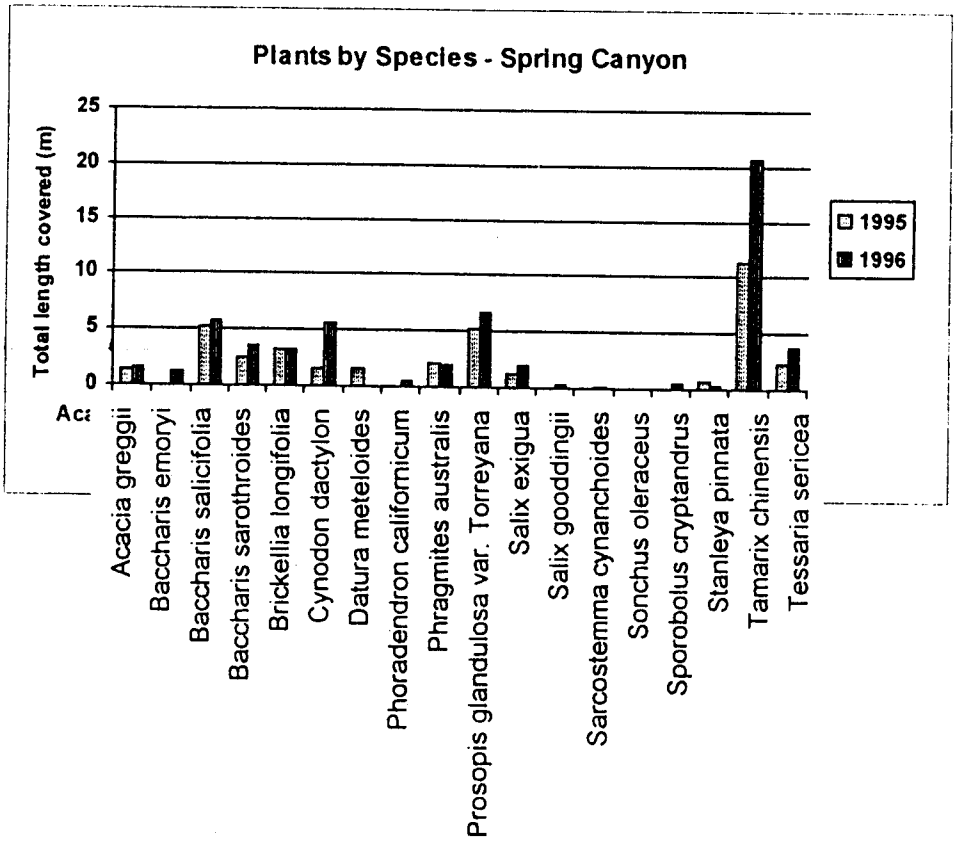

Figure 14. Changes to each plant species

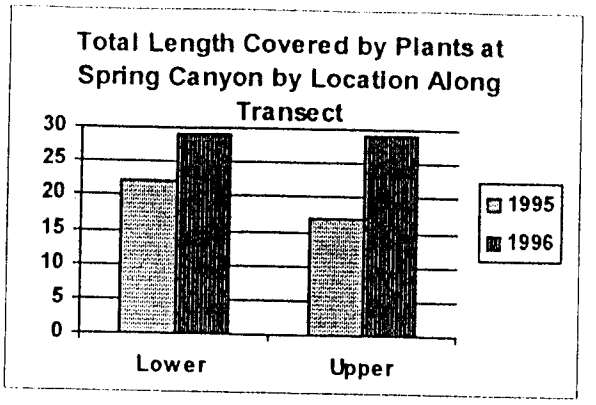

Figure 15. Changes in productivity due to Test Flow

Conclusions

The Test Flow did impact the plants that are culturally significant to the Southern Paiute people. The impacts were either positive or negligible. For example, the initial scouring and burial of plants, such as willow *(Salix exigua)* that reproduce vegetatively, resulted in an increase in the abundance of those plants. Nevertheless, the long term impacts of the increase of introduced species, such as bermuda grass *(Cynodon dactylon)*, are unknown. Also, the effects of the availability of water to plants within the old high water zone are not immediately apparent. Thus, each of these monitoring sites will be visited again in 1997 and reevaluated.

Additional Cultural Resource Monitoring

The Colorado River Corridor, as home to the Southern Paiute people for generations, includes many places that are significant in Southern Paiute culture (see Stoffle, Halmo, Evans, and Austin 1994; Stoffle et al. 1995). Both sites with archaeological evidence and traditional cultural properties (TCPs) were visited by Southern Paiutes for spiritual purposes. Three of these places lie within the area impacted by the Test Flow. The SPC research also evaluated the impact of the Test Flow on Southern Paiute TCPs within the 45,000 cfs water level.

H_{O2}: The Test Flow will not impact the Southern Paiute archaeological sites or TCPs.
H_{A2}: The Test Flow will impact the Southern Paiute archaeological sites and/or TCPs.

Methods

Photographs at each archaeological site and TCP were selected from the SPC and GCES archives for replication in the Test Flow study. Three sites within the 45,000 cfs water level were visited between May 8-22, 1996 (see Table 2). Methods included both nonpermanent and permanent measures. Nonpermanent measures included identifying the presence or absence of erosion, gullying, bank slumpage, and river-based streams, and assessing the overall condition of the TCPs. Photography was used as a permanent measure of impacts at every site. Changes in human impacts to all sites, as influenced by changes in beaches due to the Test Flow, were

evaluated during the SPC regular monitoring program in 1996.

Table 2. Additional Archaeological Monitoring Sites

Site Name	Method of Monitoring	Baseline Year
Bedrock Canyon	Photography, visual analysis	995
Vulcan's Anvil	Photography, visual analysis	992
Pumpkin Spring	Photography, visual analysis	992

Results

The impacts of the Test Flow on the cultural resource sites within each monitoring site were determined by combining the results of the various methods. Each site is discussed separately in the following sections.

Bedrock Canyon. Qualitative assessments of the site and photographs taken from designated photo points indicate that the site received few impacts from the Test Flow. The site has serious trailing problems on the sand slope between the fire pit and the rock ring and in a circle around the fire pit. There is evidence of recent use within the past few months, although the use does not appear to be as heavy as that observed during 1995.

Vulcan's Anvil. During the Test Flow, the water flowing past Vulcan's Anvil rose. No observable impacts to the Anvil were noted during the May 1996 research. Human impacts to the Anvil continue to be minimal; one sandal was found on the Anvil.

Pumpkin Spring. During the Test Flow, the Colorado River rose above the level of Pumpkin Spring and cleared out the algae and debris that had accumulated there during the past several years. No additional impacts to the spring were noted.

Conclusions

The Test Flow did not impact either Bedrock Canyon or Vulcan's Anvil. However, the Test Flow did impact Pumpkin Spring. The impacts to Pumpkin Spring were determined to be positive because the Colorado River water cleansed the mineral spring as it regularly did in the years before Glen Canyon Dam was built.

Beach Monitoring

Human visitors impact Southern Paiute cultural resources in the Colorado River Corridor (see Stoffle, Halmo, Evans, and Austin 1994; Stoffle, Austin, Fulfrost, Phillips, and Drye 1995; Stoffle et al. 1995). A principal objective of the Test Flow was to *preserve and restore camping beaches* (Wegner, Stevens, and Melis 1995). Consequently, the Test Flow had the potential to

impact cultural resources through impacts to the beaches. The SPC research also evaluated the impact of the Test Flow on beaches that provide visitor access to Southern Paiute cultural resources.

H_{03}: The Test Flow will not impact the beaches that provide visitor access to specific Southern Paiute cultural resources.

H_{A3}: The Test Flow will impact the beaches that provide visitor access to specific Southern Paiute cultural resources.

Methods

Photographs of the relevant beaches were taken from SPC and GCES archives. In addition, beach camping studies (e.g., Kearsley and Warren 1993) were reviewed. Seven selected beach monitoring sites were visited during May 1996 (see Table 3). Photography was used at each site as a permanent measure of impacts. Qualitative assessments of beach condition were also made and recorded.

Results

The impacts of the Test Flow on beaches providing access to the eleven selected cultural resource sites were determined by visual analysis. The results are summarized in Table 3.

Table 3. Results of Beach Analysis

Site Name	Observed Impacts	Baseline year
Petroglyph beach	Sand deposition	1996
Jackass Canyon beach	Moderate sand deposition at lower edge of impacted area with 30-50cm of erosion along the upper edge	1995
South Canyon beach	Moderate sand deposition	1995
Nankoweap beach	Little impact	1995
Tanner beach	Moderate sand deposition and erosion	1995
Deer Creek beach	Moderate sand deposition	1995
Vulcan's Anvil beach	Moderate sand deposition	1995
Whitmore beach	Heavy sand deposition - 1.5m high and 20m wide, extending 10m beyond the old shoreline	1995
Above Parashant beach	Little impact	1995
Ompi Cave beach	Moderate sand deposition	1995
Spring Canyon beach	Heavy sand deposition - 1.5m high just upstream from the mouth of the creekbed; up to 4cm thick layer of silt deposited on rocks, possibly from a quiet backwater that formed behind the sand during the flood	1995

Conclusions

The Test Flow did impact the beaches that provide visitor access to specific Southern Paiute cultural resources. At several monitoring sites, sand was deposited and access to the site was improved. Whether or not enough additional sand was deposited to make the beach a more frequently used camp for visitors could not be determined by this study. The SPC intends to obtain that information from the report of the research team funded during the Test Flow to investigate camping beaches.

Monitoring the Impact on the SPC Program

The SPC cultural resource monitoring program has been geographically tied to the Glen Canyon Environmental Studies (GCES) base network and included in the GCES Geographic Information System (GIS), where possible (see Stoffle, Austin, Fulfrost, Phillips, and Drye 1995). One goal of that program is to ensure its long term viability. The program has been developed to provide information that can be readily imported to the GCES GIS system, so key monitoring sites have been located by surveyors. However, the reliance on surveyors is being carefully reviewed in light of potential budget and personnel cuts. Thus, SPC monitoring sites were selected to evaluate the efficacy of incorporating surveyed monitoring program reference points by using both survey and non-survey dependent techniques for locating the sites. Several of these sites lie within the area impacted by the Test Flow. The SPC research evaluated the impact of the Test Flow on the non-survey dependent monitoring program reference points.

H_{O4}: The Test Flow will not impact the non-survey dependent SPC monitoring program reference points.

H_{A4}: The Test Flow will impact the non-survey dependent SPC monitoring program reference points.

Methods

At each monitoring site, the monitoring team used site maps and photos to relocate site boundaries, transect endpoints, and/or plot corners. The monitoring team attempted to relocate these reference points before the GCES surveyors arrived on the site. When necessary, the monitoring team requested the assistance of the surveyors to either identify or confirm reference points. Where the surveyors were required, the monitoring team recorded whether the failure to locate the reference points was attributed to changes due to the Test Flow or not. In each case, the monitoring team attempted to add additional reference points and/or photo documentation to ensure that the reference points could be relocated in the future without surveying.

Results

The results of the evaluation of reference points at each site are described below. While at each site, the monitoring team also assessed whether any additional changes were required in the monitoring program. The results of that assessment are also recorded in this section.

Petroglyph Beach.

The Test Flow deposited sand along the beach below this site, making the beach readily accessible to visitors. The deposition did not impact SPC monitoring, but the transects should be reinstalled with the assistance of a botanist to establish a firm baseline for future monitoring.

Ferry Swale.

The Test Flow deposited sand along the beach adjacent to the swale. The deposition did not impact SPC monitoring, but the transects should be reinstalled with the assistance of a botanist to establish a firm baseline for future monitoring.

Jackass Canyon.

The Test Flow deposited sand along the beach downstream of this site. The deposition did not impact SPC monitoring because the transect endpoints and photo points are located on large boulders at the river's edge. Visitor use at this site is high. The visitors access the site via Jackass Canyon rather than from the river, so the sand deposition does not appear to be related to visitor use.

Nankoweap. The Test Flow did not impact the monitoring unit at this site; sand was neither added nor eroded.

Bedrock Canyon. The Test Flow deposited sand above and below the wash, making boat landing relatively easy. The deposition did not impact the SPC monitoring. However, the evidence of increased trailing at the site, some of which was caused by archaeology monitors, led the SPC research team to adjust the monitoring activities to avoid actually entering the site. Remote photo points were established across the wash from the site, and the plant monitoring was done from within the wash and at the edges of the plot.

Vulcan's Anvil. The Test Flow deposited sand along the beach adjacent to Vulcan's Anvil. The deposition did not impact SPC monitoring because the transect endpoints and photo points are located on large boulders at the river's edge.

Whitmore Wash. The Test Flow deposited sand at the upriver end of this site. The deposition did impact SPC monitoring because the original beach was completely submerged in sand and there are no large boulders or other permanent markers at the river's edge. The monitors relied on GCES surveyors to confirm the relocation of transect points.

Above Parashant. The Test Flow had no impact on the amount of sand at this beach.

Spring Canyon. The Test Flow deposited sand at the mouth of Spring Canyon and the upriver edge of the delta. The deposition did not impact SPC monitoring because the eleven transects installed at this site must be relocated by surveyors to ensure that they record any changes in the

width of the stream bed.

Pumpkin Spring. The Test Flow deposited sand along the bank immediately downriver of this site. The deposition did not impact SPC monitoring.

Conclusions

The Test Flow did not impact the majority of the non-survey dependent SPC monitoring program reference points. A few of the reference points that were located at the shoreline of the Colorado River were covered with sand or scoured away. At those locations, photographs and compass readings were used along the transect lines to relocate the points. Where surveyors were required to relocate the points, additional photographs and compass readings were taken or transect lines were extended to ensure that points could be relocated again in the future.

The GCES surveyors assisted in the relocation of reference points at six sites. Nevertheless, due to the significant time required by the surveyors to locate the points, several monitoring transects and plots were adjusted so they could be more readily located. Two sites, Whitmore Wash and Spring Canyon, still require surveyors to locate transect endpoints. The frequency with which these sites will be monitored and the possibility of changing monitoring methods must be reviewed in 1997.

At a couple of sites, monitoring by multiple groups appears to be impacting the site. Therefore, it is recommended that the SPC try to reach a cooperative agreement with the NPS regarding when, how often, and by whom certain sites will be monitored.

Discussion

The 1996 Beach/Habitat Building Test Flow was a significant positive step in the process of trying to manage the Glen Canyon Dam so that its impact on the Colorado River ecosystem below the dam is minimized. The SPC recognizes that the dam has caused tremendous changes to that ecosystem. For example, the terraces along the river are no longer enriched by the sediments and nutrients washed down into the Colorado River Corridor. In addition, land use practices in the Colorado River watershed contribute to changes in that ecosystem, such as through the introduction of non-indigenous plant species. Consequently, invasive plants that compete with native resources are carried down the river to compete with the seeds of plants used for food, medicine, and construction that were traditionally replenished following seasonal floods. The complex nature of these changes require care when recommendations are made regarding the application of traditional Paiute resource management to the Colorado River ecosystem in its present state. Nevertheless, the results of the 1996 Test Flow indicate that flows that mimic even relatively small floods can benefit resources of cultural significance to Southern Paiutes. For example, as was observed at Jackass Canyon, the high water served a role similar to that of Southern Paiutes who traditionally gathered plants such as willow (*Salix exigua*) by breaking the stems near the ground and thereby encouraging vegetative reproduction. Whether the flood enhances the growth and reproduction of invasive species at the cost of indigenous

species or the deposition of sand along the corridor has any long term impact on erosion at culturally significant sites remain to be seen.

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